**HRS DOCUMENTATION RECORD--REVIEW COVER SHEET**

| | |
|---|---|
| Name of Site: | Dorado Ground Water Contamination |
| EPA ID No.: | PRN000201872 |
| Date Prepared: | April 2016 |

Contact Persons


| | |
|---|---|
| Site Investigations: | Denise Zeno<br>(212) 637-4319<br>U.S. Environmental Protection Agency<br>New York, NY |
| Documentation Record: | Ildefonso Acosta<br>(212) 637-4344<br>U.S. Environmental Protection Agency<br>New York, NY |


Pathways, Components, or Threats Not Scored

The surface water, soil exposure, and air pathways were not scored because the listing decision is not significantly affected by those pathways. The site score is sufficient to list the site on the ground water pathway score.

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**HRS DOCUMENTATION RECORD**

| | | |
|---|---|---|
| Name of Site: | Dorado Ground Water Contamination | Date Prepared: April 2016 |
| EPA ID No.: | PRN000201872 | |
| EPA Region: | 2 | |

| | |
|---|---|
| Street Address of Site:* | PR-694 Km 4.5, Dorado, PR 00646 |
| County and State: | Municipality of Dorado, Puerto Rico |
| General Location in State: | northeastern Puerto Rico |
| Topographic Map: | Vega Alta, PR |
| Latitude:* | 18° 25' 47.12" North (18.42975602°) |
| Longitude:* | 66° 16' 41.95" West (-66.27832042°) |
| Site Reference Point: | public supply well Maguayo 6 |

The site consists of a ground water plume with no identified source of contamination. Therefore, the reference point for the street address and site latitude/longitude coordinates is one of the contaminated wells near the center of the area of observed contamination (i.e., Maguayo 6). The Maguayo 6 well is located at the northeast corner of an athletic park along PR-694.

[Figure 1; Refs. 1, p. 51595; 4, p. 1; 5, p. 36; 6, p. 8; 7, pp. 4, 10; 10, pp. 3, 11-12]

* The street address, coordinates, and contaminant locations presented in this Hazard Ranking System (HRS) documentation record identify the general area where the site is located. They represent one or more locations EPA considers to be part of the site based on the screening information EPA used to evaluate the site for NPL listing. EPA lists national priorities among the known "releases or threatened releases" of hazardous substances; thus, the focus is on the release, not precisely delineated boundaries. A site is defined as where a hazardous substance has been "deposited, stored, placed, or otherwise come to be located." Generally, HRS scoring and the subsequent listing of a release merely represent the initial determination that a certain area may need to be addressed under CERCLA. Accordingly, EPA contemplates that the preliminary description of facility boundaries at the time of scoring will be refined as more information is developed as to where the contamination has come to be located.

Scores

| | |
|---|---|
| Ground Water Pathway | 100.00 |
| Surface Water Pathway | Not Scored |
| Soil Exposure Pathway | Not Scored |
| Air Pathway | Not Scored |
| **HRS SITE SCORE** | 50.00 |

**WORKSHEET FOR COMPUTING HRS SITE SCORE**
**Dorado Ground Water Contamination**

| | | S | $S^2$ |
|---|---|---|---|
| 1. | Ground Water Migration Pathway Score ($S_{gw}$)<br>(from Table 3-1, line 13) | 100.00 | 10,000 |
| 2a. | Surface Water Overland/Flood Migration Component<br>(from Table 4-1, line 30) | Not Scored | |
| 2b. | Ground Water to Surface Water Migration Component<br>(from Table 4-25, line 28) | Not Scored | |
| 2c. | Surface Water Migration Pathway Score ($S_{sw}$)<br>Enter the larger of lines 2a and 2b as the pathway score. | Not Scored | |
| 3. | Soil Exposure Pathway Score ($S_s$)<br>(from Table 5-1, line 22) | Not Scored | |
| 4. | Air Migration Pathway Score ($S_a$)<br>(from Table 6-1, line 12) | Not Scored | |
| 5. | Total of $S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2$ | 10,000 | |
| 6. | **HRS Site Score** Divide the value on line 5<br>by 4 and take the square root | 50.00 | |

**GROUND WATER MIGRATION PATHWAY SCORESHEET**
**Dorado Ground Water Contamination**

| GROUND WATER MIGRATION PATHWAY<br>Factor Categories & Factors | MAXIMUM VALUE | VALUE ASSIGNED |
|---|---|---|
| | | |
| **Likelihood of Release** | | |
| 1. Observed Release | 550 | 550 |
| 2. Potential to Release | | |
| 2a. Containment | 10 | not scored |
| 2b. Net Precipitation | 10 | not scored |
| 2c. Depth to Aquifer | 5 | not scored |
| 2d. Travel Time | 35 | not scored |
| 2e. Potential to Release [lines 2a(2b+2c+2d)] | 500 | not scored |
| 3. Likelihood of Release | 550 | 550 |
| | | |
| **Waste Characteristics** | | |
| 4. Toxicity/Mobility | * | 1,000 |
| 5. Hazardous Waste Quantity | * | 100 |
| 6. Waste Characteristics | 100 | 18 |
| | | |
| **Targets** | | |
| 7. Nearest Well | 50 | 50 |
| 8. Population | | |
| 8a. Level I Concentrations | ** | 274,725 |
| 8b. Level II Concentrations | ** | 9,181.63 |
| 8c. Potential Contamination | ** | not scored |
| 8d. Population (lines 8a+8b+8c) | ** | 283,906.63 |
| 9. Resources | 5 | not scored |
| 10. Wellhead Protection Area | 20 | not scored |
| 11. Targets (lines 7+8d+9+10) | ** | 283,956.63 |
| | | |
| 12. Aquifer Score (lines 3x6x12 divided by 82,500) | 100 | 100 |
| | | |
| **13. Ground Water Migration Pathway Score (Sgw)** | 100 | 100.00 |
| | | |

* Maximum value applies to waste characteristics category.
** Maximum value not applicable.

## REFERENCES

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## SITE SUMMARY

The Dorado Ground Water Contamination (DGWC) site (EPA ID No. PRN000201872) consists of a ground water contaminant plume, but the contamination cannot be clearly attributed to any specific source (see below and **Section 3.1.1**). The plume is located within the municipality (translated from “municipio”) of Dorado in north-central Puerto Rico [Figure 1; Refs. 3, p. 1; 4, p. 1; 5, pp. 10, 17−20, 29−36]. The geographic coordinates of the site are 18° 25' 47.12" north latitude (18.42975602°) and 66° 16' 41.95" west longitude (-66.27832042°), based on the location of supply well Maguayo 6 near the center of the area of observed ground water contamination [Figure 1; Refs. 1, p. 51595; 4, p. 1; 6, p. 8; 7, pp. 4, 10; 10, p. 3]. **Figure 1** shows the site location and the area of observed ground water contamination.

There are two active water supply systems in Dorado for which ground water wells are primary contributors: Maguayo and Dorado Urbano, serving populations of 36,630 and 31,061, respectively [Ref. 10, pp. 1−4, 86−87, 96]. At least one well in the Dorado Urbano system has also been used to provide emergency water to other areas of the island impacted by drought [Ref. 6, p. 7]. There is also an inactive system, Vivoni, which consisted of the Vivoni well located south (i.e., upgradient) of the other wells [Ref. 10, pp. 86−87, 96]. These ground water systems are operated as a public utility by Puerto Rico Aqueduct and Sewer Authority (PRASA) [Refs. 7, p. 3; 9, p. 1; 10, pp. 1−4, 28−30, 96]. Wells in the Maguayo and Dorado Urbano systems have shown detections of volatile organic compounds (VOC), primarily tetrachloroethylene (PCE) and trichloroethylene (TCE), since the 1980s [Refs. 9, all pages; 23, pp. 1−2; 27, pp. 8−23]. The U.S. Geological Survey (USGS) reported PCE and TCE detections for samples collected from Maguayo and Dorado Urbano system wells during the period November 1984 to May 1985 [Ref. 23, pp. 1−2]. PRASA and Puerto Rico Department of Health (PRDOH) documentation indicates detections for the Maguayo and Dorado Urbano system wells for the time period 1996 to 2000 [Ref. 27, pp. 8−23]. PRASA data sheets for well samples collected from 2002 to 2015 show the ongoing presence of PCE and TCE in Dorado-area ground water [Ref. 9, all pages]. Some reported concentrations have exceeded maximum contaminant levels (MCL), and since the 1990s some wells have been closed either temporarily or permanently; the available documentation does not cite rationale for the well closures [Refs. 2, pp. 4−5; 10, pp. 1−2, 29−30, 35, 38, 96; 27, pp. 1, 8−23].

Since 2008, EPA has made multiple attempts to identify the source or sources of contamination in the general area of the ground water plume. In 2008, EPA launched the Maguayo Site Discovery Initiative (SDI) as an effort to identify possible hazardous waste sites in the vicinity of the contaminated wells [Refs. 26, p. 3; 29, pp. 3−4]. After a sampling effort confirmed contamination in the Dorado area public supply wells, EPA conducted windshield surveys, file searches and reviews, and site reconnaissance activities to identify possible source facilities [Refs. 26, pp. 10−15, 144−170; 29, pp. 3−5, 11−28]. Based on the efforts, EPA identified 21 facilities for further investigation [Ref. 29, p. 28]. Through environmental database searches and reconnaissance activities, EPA also identified other industrial facilities in the vicinity of the ground water contamination [Figure 2; Refs. 24, p. 170; 29, pp. 11−20]. **Figure 2** shows the locations of possible source facilities.

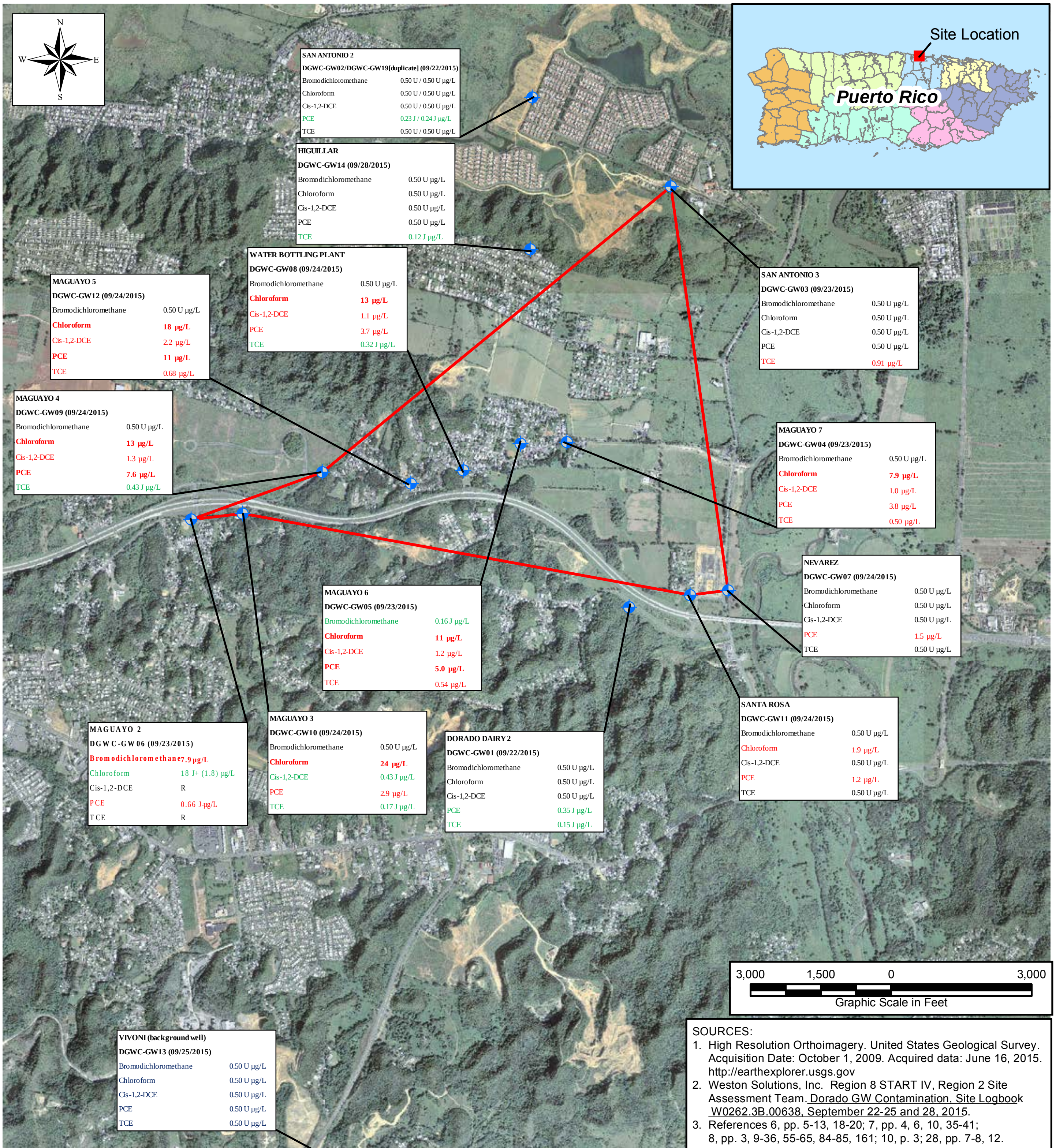
In 2011 and 2013, EPA conducted Preliminary Assessment/Site Inspections (PA/SI) sampling at the 21 facilities identified for further investigation and, in 2015, EPA conducted Site Reassessment (SR) sampling at 5 of the facilities. The sampling efforts included collection of surface soil samples, subsurface soil samples, and ground water samples (if ground water was encountered) from each facility; the sampling effort at one active dry-cleaning facility also included the collection of soil gas samples [Refs. 30 through 50; see **“Other Possible Sources” in Section 3.1.1**]. Analytical results documented the presence or apparent presence of chlorinated solvents at several facilities, whereas there were no detections at other facilities; however, there are no intervening data to clearly connect any of the facilities to the supply well contamination (see **Figure 2**). In addition, the heterogeneous nature of the underlying karst limestone aquifer makes it difficult to determine where contamination originates [Refs. 20, pp. 13, 32; 22, pp. 49−52, 60−61]. Although some of the possible source facilities are more than 1 mile from the contaminated wells, pumping of supply wells in a karst aquifer could affect ground water flow over areas large enough to capture contamination from one or more distant sources in several directions [Figure 2; Refs. 20, pp. 3, 10, 13; 21, pp. 11−15; 22, pp. 8−12, 31, 36, 51−52, 63]. Due to this karst nature of the site, further sampling is not likely to identify a source of the contamination and this additional effort would be beyond the scope of an HRS evaluation.

In June 2015, PRASA provided VOC analytical results spanning the time frame from May 2012 to May 2015 [Ref. 9, pp. 301−308]. The most recent available PCE result for Maguayo 5, for a sample collected in August 2013, indicated a concentration of 5.9 µg/L, an exceedance of the MCL (5 µg/L) [Refs. 2, p. 4; 9, pp. 301, 304]. A sample collected from Maguayo 6 in March 2015 reported a PCE result of 5.6 µg/L, also an exceedance of the MCL; that result was followed by a reported concentration of 4.0 µg/L for a sample collected from Maguayo 6 in April 2015 [Ref. 9, p. 305]. Analytical results for Maguayo 7 since 2012 appear to show a general upward trend of PCE concentrations, from 2.1 µg/L in September 2012 to the maximum-to-date concentration of 3.5 µg/L in April 2015 [Ref. 9, pp. 305−306]. A single result for Maguayo 3 in January 2013 shows a similar concentration (3.4 µg/L) to Maguayo 7 [Ref. 9, p. 304]. The PCE results for the Maguayo 2, Nevárez, and Santa Rosa wells are consistently below the MCL, ranging from approximately 1 µg/L to 2 µg/L in each of those wells [Ref. 9, pp. 303−304, 306−308]. In general, the maximum reported PCE concentrations within the plume appear to have increased since 2002 [Ref. 9, pp. 2−3, 301−308]. The maximum TCE concentrations within the plume appear to have decreased [Ref. 9, pp. 1−3, 123−124, 301−308].

Maguayo System—The blended Maguayo system is composed of six ground water sources, wells Maguayo 2 through Maguayo 7 [Ref. 10, pp. 1−4]. As of September 2015, Maguayo 2, Maguayo 6, and Maguayo 7 are active wells; Maguayo 3 and Maguayo 5 are inactive with the pumps intact and operable; and Maguayo 4 is inactive with the pump damaged or removed (the available documentation does not indicate the rationale for the inactivity) [Refs. 6, pp. 7−12, 25−32; 7, p. 6]. Previous analytical results have indicated the presence of PCE and TCE in all the Maguayo wells [Refs. 9, pp. 2−3, 301−306; 26, p. 197].

Dorado Urbano System—The ground water component of the blended Dorado Urbano system is composed of the following wells: San Antonio 1, San Antonio 2, San Antonio 3, Higuillar, Dorado Dairy 1, Dorado Dairy 2, Nevárez, and Santa Rosa [Ref. 10, pp. 1−4]. As of September 2015, Nevárez and Santa Rosa are active; all other wells are inactive with the pumps removed [Refs. 6, pp. 6−10, 18−19, 21−24, 27, 37; 7, p. 6]. Previous analytical results have indicated the presence of PCE and TCE in all the Dorado Urbano wells [Ref. 9, pp. 123−124, 301−308].

In September 2015, EPA collected samples for VOC analysis from active and inactive wells in Dorado [Refs. 6, pp. 3−13, 18−32, 37; 7, pp. 3−6, 10, 18−41]. The results confirm the continuing presence of VOCs in the wells, including MCL exceedances for PCE in one active and two inactive wells [Refs. 2, p. 4; 7, pp. 6, 10, 35−38; 8, pp. 13−32; 51, pp. 3−4, 98, 112−113, 124−125, 138, 178, 188−189, 200−201, 212−213, 225, 236−237, 247−248]. The results for inactive wells at several locations surrounding the plume exhibit background levels, including non-detect results for all VOC parameters in the sample collected from the Vivoni well located south of the plume [Refs. 7, pp. 6, 10, 33−34, 37−41; 8, pp. 3, 9−12, 33−36, 75, 84−85; 51, pp. 2, 4, 34−35, 48−49, 59−60, 259−260; 52, pp. 2, 32−33]. Although possible sources of the VOCs in ground water have been identified, the contamination has not been shown to be attributable to any specific source or sources (see **Section 3.1.1**).




SOURCES:
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3. References 6, pp. 5-13, 18-20; 7, pp. 4, 6, 10, 35-41; 8, pp. 3, 9-36, 55-65, 84-85, 161; 10, p. 3; 28, pp. 7-8, 12.

Legend
Water Supply Well Sample Location - September 2015
Results are presented as follows:
BLUE TEXT Background Level
RED TEXT Observed Release Concentration
**BOLD RED TEXT** Observed Release Concentration above HRS Benchmark
GREEN TEXT Detection of Contaminant of Concern (COC)
Area of Observed Ground Water Contamination (Source 1)

Legend
µg/L micrograms per liter
U The analyte was not detected at or above the adjusted Contract Required Quantitation Limit for sample and method.
J The analyte was positively identified and the associated numerical value is the approximate concentration.
J+ The result is an estimated quantity, but the result may be biased high.
J- The result is an estimated quantity, but the result may be biased low.
R The result is unusable due to the quality of the data.

Weston Solutions, Inc.
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TITLE:
# Site and Source Location Map

PROJECT: Dorado Ground Water Contamination

CLIENT NAME: EPA

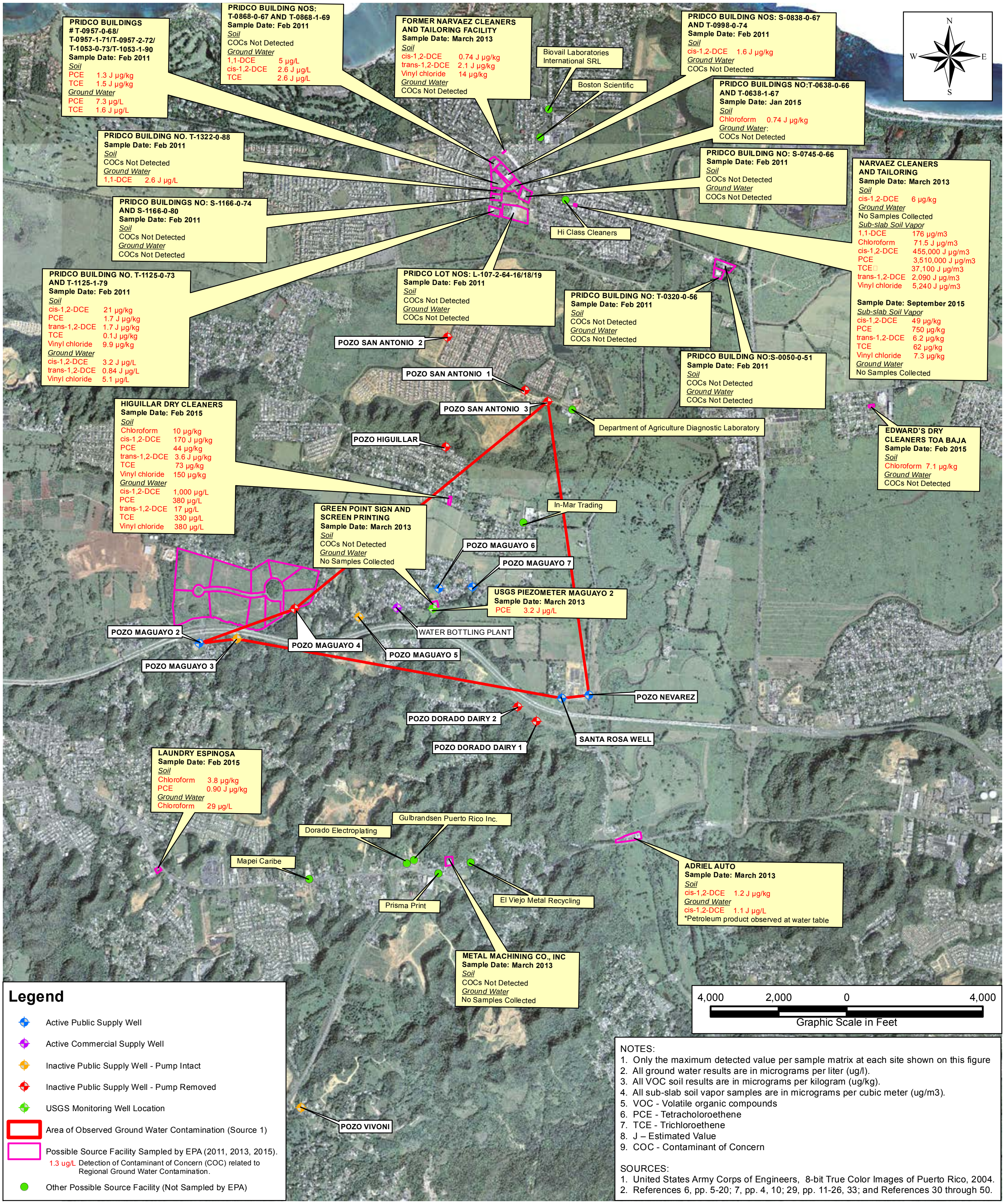
CONTRACT No. EP-S8-13-01

DATE: February 2016

WO #: 20408.012.004.0262.00

Figure #: 1

P:\SAT2\SAT-Region8START\Dorado GW HRS (0262)\MXD\17581_Dorado_Water_Suppl_Well_Plume_Map_R1_8.5X11.mxd




Document Path: P:\SAT2\SAT-Region8START\Dorado GW HRS (0262)\MXD\17580_Maguayo_Study_Area_rev21016_8.5X11.mxd

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TITLE:

# Locations of Other Possible Sources

PROJECT: Dorado Ground Water Contamination

CLIENT NAME: EPA

CONTRACT No. EP-S8-13-01

DATE: February 2016

WO #: 20408.012.004.0262.00

Figure #: 2

## 2.2 SOURCE CHARACTERIZATION

Number of the source: 1

Source Type of the source: Other

Name and description of the source: Ground Water Plume – Dorado, Puerto Rico

Source 1 is considered a contaminated ground water plume of unknown volume without an identified source. Results reported by USGS, PRDOH, PRASA, and the Puerto Rico Environmental Quality Board (PREQB) since the 1980s for PRASA-operated wells in the Dorado area have indicated the constant presence of PCE and TCE in Dorado area wells [Refs. 9, all pages; 23, p. 2; 26, p. 4; 27, pp. 8−23]. EPA collected ground water samples from public supply wells and a well at a water bottling plant (see note below) in September 2015 [Refs. 6, pp. 4−13, 19; 7, pp. 3−6]. Analytical results indicated the presence of bromodichloromethane, chloroform, cis-1,2-DCE PCE, and TCE in the samples, at concentrations significantly above the background levels in the upgradient Vivoni well and other wells exhibiting background concentrations (see **Section 2.4.1**). The PCE concentrations in three wells (Maguayo 4, Maguayo 5, and Maguayo 6) exceed the EPA MCL of 5 µg/L [Refs. 2, p. 4; 7, pp. 6, 35−38; 8, pp. 1−8, 58, 61, 64; 51, pp. 3−4, 125, 201, 248]. The Maguayo 6 well is currently active and contributing to the blended Maguayo water supply system; Maguayo 4 and Maguayo 5 are currently inactive but are still considered as viable components of the system [Refs. 7, pp. 6, 22, 26, 29; 10, pp. 35, 38, 40]. Other active wells that exhibit observed release concentrations include Maguayo 2, Maguayo 7, Nevárez, and Santa Rosa [Refs. 7, p. 6; 8, pp. 1−8, 57, 59−60, 63−64; 51, pp. 3−4, 112−113, 138, 178, 236−237].

In July 2015, EPA conducted a reconnaissance of the Maguayo and Dorado Urbano well systems to determine their condition and accessibility for sampling [Ref. 5, pp. 1−36]. During the reconnaissance and the follow-up sampling in September 2015, the following wells were observed to be active: Santa Rosa, Nevárez, Maguayo 2, Maguayo 6, and Maguayo 7 [Refs. 5, pp. 26−27, 35−36; 6, pp. 7−12; 7, p. 6]. Some of the wells, including Maguayo 3 and Maguayo 5, are inactive but have intact infrastructure (i.e., pump and electrical connections) [Refs. 6, pp. 9−12, 29−32; 7, pp. 27, 29]. The remaining wells are in various states of disrepair, ranging from disconnected electrical power, to missing a pump, to consisting of only an open well casing [Refs. 5, pp. 2−15, 29−30; 6, pp. 3−13, 21−32; 7, pp. 18−31]. Although PRASA has discontinued the use of some wells, periodic drought conditions necessitate further use of some contaminated wells [Refs. 21, p. 11; 26, p. 3−4; 29, pp. 3, 6]. During the sampling event, the Santa Rosa well was being used to fill water supply tanker trucks [Ref. 6, p. 7]. The populations served and duration of emergency service is unknown, so it is unclear what populations meet the definition of regularly using the water; therefore, the emergency service is not considered in population apportionment for scoring the site [Ref. 1, p. 51603].

Note: The water bottling plant withdraws water from a well that is 300 feet deep; prior to bottling and distribution, the water is purified using several treatment methods, including multimedia filters, activated carbon, water softeners, reverse osmosis (RO), ultraviolet rays, micro filtration, and recirculated ozone [Refs. 5, p. 34; 10, pp. 92, 96−97].

**Location of the source, with reference to a map of the site:**

The ground water plume is identified by contamination found in the following water supply wells [Refs. 6, pp. 7−13; 7, pp. 6, 20−30; 8, pp. 1−8, 56−64; 51, pp. 3−4, 98, 112−113, 124−125, 138, 178, 188−189, 200−201, 212−213, 225, 236−237, 247−248]:

- Active wells: Maguayo 2, Maguayo 6, Maguayo 7, Nevárez, Santa Rosa, water bottling plant
- Inactive wells (pump intact): Maguayo 3, Maguayo 5
- Inactive wells (pump inoperable or removed): Maguayo 4, San Antonio 3

For the purpose of this report, these wells represent a minimum of the plume extent. The site is located in northeastern Puerto Rico and is shown in **Figure 1**.

**Containment**

Release to ground water:

Based on evidence of hazardous substance migration (i.e., detections significantly above background in ground water samples from the Maguayo 2, Maguayo 3, Maguayo 4, Maguayo 5, Maguayo 6, Maguayo 7, Nevárez, Santa Rosa, Dorado Ice & Water, and San Antonio 3 wells) and due to the fact that there is nothing to prevent the plume from migrating further, a containment factor of 10 is assigned [Refs. 1, p. 51596; 7, pp. 6, 35−38; 8, pp. 1−3, 56−64; 51, pp. 2−4, 34−35, 48−49, 59−60, 98, 112−113, 124−125, 138, 178, 188−189, 200−201, 212−213, 225, 236−237, 247−248, 259−260; 52, pp. 2, 32−33].

### 2.4.1 Hazardous Substances

Ground water samples collected by EPA in 2015 showed the presence of volatile organic compounds (VOC) at observed release concentrations (i.e., significantly above background levels) in Dorado area supply wells, as described below and discussed in more detail in **Section 3.1.1**.

**EPA Sampling Event – Ground Water Samples: September 2015**

In September 2015, EPA collected ground water samples from five active water supply wells and eight inactive water supply wells owned by PRASA and from one commercial production well operated by a water bottling plant [Refs. 6, pp. 3−13, 18−32, 37; 7, pp. 3−6, 10, 18−31]. All samples consisted of raw water collected prior to any on-site treatment [Ref. 7, pp. 3−6]. The water bottling plant did not have a sampling spigot prior to its 2,000-gallon holding tank; therefore, the sample from that well (DGWC-GW08) was collected after passing through the storage tank, which has continuous flow-through [Refs. 6, p. 11; 7, pp. 4, 25]. The ground water samples were analyzed for Organic Target Analyte List (TAL) VOCs (trace concentration) according to *EPA Contract Laboratory Program [CLP] Statement of Work for Organic Superfund Methods, Multi-Media, Multi-Concentration, SOM02.2*, under CLP Case No. 45651 [Refs. 8, pp. 1−4; 51, pp. 16−18; 52, pp. 13−15]. The quantitation limit reported for each result was the contract-required quantitation limit (CRQL) adjusted for sample and method [Ref. 8, pp. 3, 75]. Since the samples were analyzed through CLP, these adjusted CRQLs are used in place of the HRS-defined sample quantitation limit (SQL) [Ref. 1, Sections 1.1 and 2.3]. Chain-of-custody was maintained for the samples throughout collection, shipping, and analysis [Refs. 7, pp. 33−39, 41; 8, pp. 4−8; 51, pp. 2−4; 52, p. 2].

Bromodichloromethane, chloroform, cis-1,2-DCE, PCE, and TCE were each detected above the applicable CRQL (0.50 μg/L, adjusted for sample characteristics when necessary) in at least one ground water sample; individual concentrations ranged from 0.50 μg/L to 24 μg/L [Refs. 1, p. 51585−51586, 51589; 8, pp. 3, 56−64; 51, pp. 3−4, 98, 112−113, 124−125, 138, 178, 188−189, 200−201, 212−213, 225, 236−237, 247−248]. Wells at several locations surrounding the plume exhibited background concentrations for site-specific hazardous substances, including non-detect results for all five substances in the sample collected from the Vivoni well to the south [Refs. 7, pp. 6, 10; 8, pp. 3, 55−56, 64−65, 75, 161; 51, pp. 2, 4, 34−35, 48−49, 59−60, 259−260; 52, pp. 2, 32−33]. Additional information regarding background levels is presented in **Section 3.1.1**.

**TABLE 1. SOURCE 1 HAZARDOUS SUBSTANCES**

| Hazardous Substance | Sample Number | Date Sampled | Result (μg/L) | CRQL (μg/L) | Reference |
|---|---|---|---|---|---|
| Bromodichloromethane | DGWC-GW06/BCJQ6 | 09/23/2015 | 7.9 | 0.50 | 7, pp. 6, 23, 35; 8, pp. 2, 4−8, 19, 59; 51, pp. 3, 138 |
| | *DGWC-GW01/BCJQ1** | *09/22/2015* | *U** | *0.50* | *7, pp. 6, 18, 33; 8, pp. 2−9, 55; 51, pp. 2, 35* |
| | *DGWC-GW02/BCJQ2** | *09/22/2015* | *U** | *0.50* | *7, pp. 6, 19, 33; 8, pp. 2−8, 11, 56; 51, pp. 2, 49* |
| | *DGWC-GW19/BCJR9* (DUP of DGWC-GW02)* | *09/22/2015* | *U** | *0.50* | *7, pp. 6, 19, 33; 8, pp. 2−8, 35, 65; 51, pp. 2, 60* |
| | *DGWC-GW13/BCJR3** | *09/25/2015* | *U** | *0.50* | *7, pp. 6, 30, 37; 8, pp. 2−8, 33, 64; 51, pp. 4, 260* |
| | *DGWC-GW14/BCJR4** | *09/28/2015* | *U** | *0.50* | *7, pp. 6, 31, 39; 8, pp. 74−84, 161; 52, pp. 2, 33* |
| Chloroform | DGWC-GW04/BCJQ4 | 09/23/2015 | 7.9 | 0.50 | 7, pp. 6, 21, 35; 8, pp. 2, 4−8, 15, 57; 51, pp. 3, 112 |
| | DGWC-GW05/BCJQ5 | 09/23/2015 | 11 | 0.50 | 7, pp. 6, 22, 35; 8, pp. 2, 4−8, 17, 58; 51, pp. 3, 124 |
| | DGWC-GW08/BCJQ8 | 09/24/2015 | 13 | 0.50 | 7, pp. 6, 25, 37; 8, pp. 2, 4−8, 23, 60; 51, pp. 4, 188 |
| Chloroform | DGWC-GW09/BCJQ9 | 09/24/2015 | 13 | 0.50 | 7, pp. 6, 26, 37; 8, pp. 2, |

| TABLE 1. SOURCE 1 HAZARDOUS SUBSTANCES | | | | | |
|---|---|---|---|---|---|
| **Hazardous Substance** | **Sample Number** | **Date Sampled** | **Result (µg/L)** | **CRQL (µg/L)** | **Reference** |
| (continued) | | | | | 4−8, 25, 61; 51, pp. 4, 200 |
| | DGWC-GW10/BCJR0 | 09/24/2015 | 24 | 2.5 | 7, pp. 6, 27, 37; 8, pp. 2, 4−8, 27, 62; 51, pp. 4, 212, 225 |
| | DGWC-GW11/BCJR1 | 09/24/2015 | 1.9 | 0.50 | 7, pp. 6, 28, 37; 8, pp. 2, 4−8, 29, 63; 51, pp. 4, 236 |
| | DGWC-GW12/BCJR2 | 09/24/2015 | 18 | 0.50 | 7, pp. 6, 29, 37; 8, pp. 2, 4−8, 31, 63; 51, pp. 4, 247 |
| | *DGWC-GW01/BCJQ1** | *09/22/2015* | *U** | *0.50* | *7, pp. 6, 18, 33; 8, pp. 2−9, 55; 51, pp. 2, 34* |
| | *DGWC-GW02/BCJQ2** | *09/22/2015* | *U** | *0.50* | *7, pp. 6, 19, 33; 8, pp. 2−8, 11, 56; 51, pp. 2, 48* |
| | *DGWC-GW19/BCJR9* (DUP of DGWC-GW02)* | *09/22/2015* | *U** | *0.50* | *7, pp. 6, 19, 33; 8, pp. 2−8, 35, 65; 51, pp. 2, 59* |
| | *DGWC-GW13/BCJR3** | *09/25/2015* | *U** | *0.50* | *7, pp. 6, 30, 37; 8, pp. 2−8, 33, 64; 51, pp. 4, 259* |
| | *DGWC-GW14/BCJR4** | *09/28/2015* | *U** | *0.50* | *7, pp. 6, 31, 39; 8, pp. 74−84, 161; 52, pp. 2, 32* |
| cis-1,2-DCE | DGWC-GW04/BCJQ4 | 09/23/2015 | 1.0 | 0.50 | 7, pp. 6, 21, 35; 8, pp. 2, 4−8, 15, 57; 51, pp. 3, 112 |
| | DGWC-GW05/BCJQ5 | 09/23/2015 | 1.2 | 0.50 | 7, pp. 6, 22, 35; 8, pp. 2, 4−8, 17, 58; 51, pp. 3, 124 |
| | DGWC-GW08/BCJQ8 | 09/24/2015 | 1.1 | 0.50 | 7, pp. 6, 25, 37; 8, pp. 2, 4−8, 23, 60; 51, pp. 4, 188 |
| | DGWC-GW09/BCJQ9 | 09/24/2015 | 1.3 | 0.50 | 7, pp. 6, 26, 37; 8, pp. 2, 4−8, 25, 61; 51, pp. 4, 200 |
| | DGWC-GW12/BCJR2 | 09/24/2015 | 2.2 | 0.50 | 7, pp. 6, 29, 37; 8, pp. 2, 4−8, 31, 63; 51, pp. 4, 247 |
| | *DGWC-GW01/BCJQ1** | *09/22/2015* | *U** | *0.50* | *7, pp. 6, 18, 33; 8, pp. 2−9, 55; 51, pp. 2, 34* |
| | *DGWC-GW02/BCJQ2** | *09/22/2015* | *U** | *0.50* | *7, pp. 6, 19, 33; 8, pp. 2−8, 11, 56; 51, pp. 2, 48* |
| | *DGWC-GW19/BCJR9* (DUP of DGWC-GW02)* | *09/22/2015* | *U** | *0.50* | *7, pp. 6, 19, 33; 8, pp. 2−8, 35, 65; 51, pp. 2, 59* |
| | *DGWC-GW13/BCJR3** | *09/25/2015* | *U** | *0.50* | *7, pp. 6, 30, 37; 8, pp. 2−8, 33, 64; 51, pp. 4, 259* |
| | *DGWC-GW14/BCJR4** | *09/28/2015* | *UJ** | *0.50* | *7, pp. 6, 31, 39; 8, pp. 74−84, 161; 52, pp. 2, 32* |
| PCE | DGWC-GW04/BCJQ4 | 09/23/2015 | 3.8 | 0.50 | 7, pp. 6, 21, 35; 8, pp. 2, 4−8, 16, 57; 51, pp. 3, 113 |
| | DGWC-GW05/BCJQ5 | 09/23/2015 | 5.0 | 0.50 | 7, pp. 6, 22, 35; 8, pp. 2, 4−8, 18, 58; 51, pp. 3, 125 |
| | DGWC-GW06/BCJQ6 | 09/23/2015 | 0.66 J- | 0.50 | 7, pp. 6, 23, 35; 8, pp. 2−8, 20, 59; 51, pp. 3, 138 |
| | DGWC-GW07/BCJQ7 | 09/24/2015 | 1.5 | 0.50 | 7, pp. 6, 24, 37; 8, pp. 2, 4−8, 22, 60; 51, pp. 4, 178 |
| | DGWC-GW08/BCJQ8 | 09/24/2015 | 3.7 | 0.50 | 7, pp. 6, 25, 37; 8, pp. 2, 4−8, 24, 60; 51, pp. 4, 189 |
| | DGWC-GW09/BCJQ9 | 09/24/2015 | 7.6 | 0.50 | 7, pp. 6, 26, 37; 8, pp. 2, 4−8, 26, 61; 51, pp. 4, 201 |
| PCE (continued) | DGWC-GW10/BCJR0 | 09/24/2015 | 2.9 | 0.50 | 7, pp. 6, 27, 37; 8, pp. 2, 4−8, 28, 62; 51, pp. 4, 213 |

| TABLE 1. SOURCE 1 HAZARDOUS SUBSTANCES | | | | | |
|---|---|---|---|---|---|
| **Hazardous Substance** | **Sample Number** | **Date Sampled** | **Result (µg/L)** | **CRQL (µg/L)** | **Reference** |
| | DGWC-GW11/BCJR1 | 09/24/2015 | 1.2 | 0.50 | 7, pp. 6, 28, 37; 8, pp. 2, 4−8, 30, 63; 51, pp. 4, 237 |
| | DGWC-GW12/BCJR2 | 09/24/2015 | 11 | 0.50 | 7, pp. 6, 29, 37; 8, pp. 2, 4−8, 32, 64; 51, pp. 4, 248 |
| | *DGWC-GW01/BCJQ1** | *09/22/2015* | *0.35J** | *0.50* | *7, pp. 6, 18, 33; 8, pp. 2−9, 55; 51, pp. 2, 35* |
| | *DGWC-GW02/BCJQ2** | *09/22/2015* | *0.23J** | *0.50* | *7, pp. 6, 19, 33; 8, pp. 2−8, 11, 56; 51, pp. 2, 49* |
| | *DGWC-GW19/BCJR9* (DUP of DGWC-GW02)* | *09/22/2015* | *0.24J** | *0.50* | *7, pp. 6, 19, 33; 8, pp. 2−8, 35, 65; 51, pp. 2, 60* |
| | *DGWC-GW13/BCJR3** | *09/25/2015* | *U** | *0.50* | *7, pp. 6, 30, 37; 8, pp. 2−8, 33, 64; 51, pp. 4, 260* |
| | *DGWC-GW14/BCJR4** | *09/28/2015* | *U** | *0.50* | *7, pp. 6, 31, 39; 8, pp. 74−85, 161; 52, pp. 2, 33* |
| TCE | DGWC-GW03/BCJQ3 | 09/23/2015 | 0.91 | 0.50 | 7, pp. 6, 20, 35; 8, pp. 2, 4−8, 13, 56; 51, pp. 3, 98 |
| | DGWC-GW04/BCJQ4 | 09/23/2015 | 0.50 | 0.50 | 7, pp. 6, 21, 35; 8, pp. 2, 4−8, 15, 57; 51, pp. 3, 112 |
| | DGWC-GW05/BCJQ5 | 09/23/2015 | 0.54 | 0.50 | 7, pp. 6, 22, 35; 8, pp. 2, 4−8, 17, 58; 51, pp. 3, 124 |
| | DGWC-GW12/BCJR2 | 09/24/2015 | 0.68 | 0.50 | 7, pp. 6, 29, 37; 8, pp. 2, 4−8, 31, 63; 51, pp. 4, 247 |
| | *DGWC-GW01/BCJQ1** | *09/22/2015* | *0.15J** | *0.50* | *7, pp. 6, 18, 33; 8, pp. 2−9, 55; 51, pp. 2, 34* |
| | *DGWC-GW02/BCJQ2** | *09/22/2015* | *U** | *0.50* | *7, pp. 6, 19, 33; 8, pp. 2−8, 11, 56; 51, pp. 2, 48* |
| | *DGWC-GW19/BCJR9* (DUP of DGWC-GW02)* | *09/22/2015* | *U** | *0.50* | *7, pp. 6, 19, 33; 8, pp. 2−8, 35, 65; 51, pp. 2, 59* |
| | *DGWC-GW13/BCJR3** | *09/25/2015* | *U** | *0.50* | *7, pp. 6, 30, 37; 8, pp. 2−8, 33, 64; 51, pp. 4, 259* |
| | *DGWC-GW14/BCJR4** | *09/28/2015* | *0.12J** | *0.50* | *7, pp. 6, 31, 39; 8, pp. 74−84, 161; 52, pp. 2, 32* |

µg/L micrograms per liter

CRQL Contract-required quantitation limit, adjusted for sample and method [Ref. 8, pp. 3, 75]

U The analyte was analyzed for, but was not detected at a level greater than or equal to the level of the adjusted CRQL for sample and method [Ref. 8, pp. 3, 75].

* Results are representative of background levels (see **Section 3.1.1**)

J The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample (due either to the quality of the data generated because certain quality control criteria were not met, or the concentration of the analyte was below the CRQL) [Refs. 8, pp. 3, 75; 28, pp. 4−8].

J- The result is an estimated quantity that might be biased low [Ref. 8, p. 3]. In accordance with the November 1996 EPA fact sheet *Using Qualified Data to Document an Observed Release and Observed Contamination*, the value is usable without adjustment [Ref. 28, pp. 4−8].

DUP Duplicate ground water sample.

## 2.4.2 Hazardous Waste Quantity

2.4.2.1.1 Hazardous Constituent Quantity (Tier A)

The total Hazardous Constituent Quantity for Source No. 1 could not be adequately determined according to the HRS requirements; that is, the total mass of all CERCLA hazardous substances in the source and releases from the source is not known and cannot be estimated with reasonable confidence [Ref. 1, pp. 51590-51591 (Section 2.4.2.1.1)]. Insufficient historical and current data [manifests, potentially responsible party (PRP) records, State records, permits, waste concentration data, etc.] are available to adequately calculate the total mass, or a partial estimate, of all CERCLA hazardous substances in the source and the associated releases from the source. Therefore, there is insufficient information to calculate a total or partial Hazardous Constituent Quantity estimate for Source No. 1 with reasonable confidence. Scoring proceeds to the evaluation of Tier B, Hazardous wastestream quantity [Ref. 1, p. 51591].

Hazardous Constituent Quantity (C) Value: NS

2.4.2.1.2 Hazardous Wastestream Quantity (Tier B)

The total Hazardous Wastestream Quantity for Source No. 1 could not be adequately determined according to the HRS requirements; that is, the total mass, or a partial estimate, of all hazardous wastestreams and CERCLA pollutants and contaminants for the source and releases from the source is not known and cannot be estimated with reasonable confidence [Ref. 1, p. 51591 (Section 2.4.2.1.2)]. Insufficient historical and current data (manifests, PRP records, State records, permits, waste concentration data, annual reports, etc.) are available to adequately calculate the total mass, or a partial estimate, of all hazardous wastestreams and CERCLA pollutants and contaminants for the source and the associated releases from the source. Therefore, there is insufficient information to adequately calculate or extrapolate a total or partial Hazardous Wastestream Quantity for Source No. 1 with reasonable confidence. Scoring proceeds to the evaluation of Tier C, Volume [Ref. 1, p. 51591].

Hazardous Wastestream Quantity (W) Value: NS

2.4.2.1.3 Volume (Tier C)

Because there are wells with samples showing contamination in the ground water but the volume of the contaminated area has not been determined, the volume of the ground water contamination is considered to be greater than 0 cubic yards but unknown [Figure 1; Refs. 7, pp. 6, 10, 35−38; 8, pp. 13−34, 56−65; 51, pp. 3−4, 98, 112−113, 124−125, 138, 178, 188−189, 200−201, 212−213, 225, 236−237, 247−248]. The source type is “Other,” so the volume value is divided by 2.5 to obtain the assigned value, as shown below [Ref. 1, p. 51591, Section 2.4.2.1.3, Table 2-5].

Dimension of source ($yd^3$): >0 $yd^3$
Volume (V) Assigned Value: (>0)/2.5 = >0

2.4.2.1.4 Area (Tier D)

Tier D is not evaluated for source type “other” [Ref. 1, p. 51591, Table 2-5, Section 2.4.2.1.4].

Area of source ($ft^2$): N/A
Area (A) Assigned Value: 0

2.4.2.1.5 Source Hazardous Waste Quantity Value

The source hazardous waste quantity value for Source 1 is >0 for Tier C - Volume [Ref. 1, p. 51591].

Source Hazardous Waste Quantity Value: >0

**SITE SUMMARY OF SOURCE DESCRIPTIONS**

| TABLE 2. HAZARDOUS WASTE QUANTITY AND CONTAINMENT | | | | | |
|---|---|---|---|---|---|
| **Source Number** | **Source Hazardous Waste Quantity Value** | **Containment** | | | |
| | | **Ground Water** | **Surface Water** | **Air (Gas)** | **Air (Particulate)** |
| 1 | >0 | 10 | NS | NS | NS |

NS = Not Scored

## 3.0 GROUND WATER MIGRATION PATHWAY

Note: Reference 19 and 20 are complete copies of published USGS reports. Original USGS pagination is used when citing these two references.

### 3.0.1 General Considerations

The aquifer being evaluated at the Dorado Ground Water Contamination site is the upper aquifer of the North Coast Limestone Aquifer System (NCLAS) (hereinafter, “NCLAS upper aquifer” or “aquifer”), which is the principal source of fresh ground water in Dorado and historically has been the principal source of public-supply and industrial water use in the region [Refs. 19, pp. 1−5; 20, pp. 1−7; 21, pp. 11−18]. The water supply wells sampled by EPA in September 2015 range in depth from 105 to 350 feet below ground surface (ft bgs) and have screened intervals in the formations that compose the NCLAS upper aquifer [Ref. 10, pp. 1−27, 47−53, 85]. Only the wells that were sampled are considered for scoring, but the NCLAS upper aquifer underlies an area of approximately 430 square miles in northern Puerto Rico, including the site and surroundings; the aquifer’s most productive area includes Dorado [Ref. 19, pp. 4−5].

The NCLAS consists of a sequence of limestone formations that dip northward toward the Atlantic Ocean [Refs. 19, p. 9; 20, p. 3]. In the Dorado area, the NCLAS upper aquifer is composed of (in descending order) the permeable parts of surficial unconsolidated deposits, the Aymamón Limestone, the Aguada Limestone, and the upper permeable parts of the Cibao formation (including all its members) [Refs. 4, p. 1; 10, p. 47; 20, p. 11; 22, pp. 51−52]. These formations are in hydraulic connection in the Dorado area and are classified as a single hydrogeologic unit [Refs. 19, pp. 4−5; 20, p. 11]. Current and former drinking water wells within and surrounding the ground water plume (i.e., Source 1) are finished in all three rock formations, including at least three wells that are reported to be finished in both the Aguada Limestone and Cibao Formation [Ref. 10, pp. 3−27, 30, 50−52, 62−63, 77−82, 85].

The NCLAS upper aquifer is overlain by unsaturated portions of the surficial unconsolidated deposits and limestone formations, which contribute varying levels of recharge to the underlying aquifer [Refs. 19, pp. 4, 6, 8; 20, pp. 1, 7, 10−11, 13, 18, 25−27; 22, p. 65]. Ground water exists under unconfined conditions within the aquifer, with the water table (i.e., the top of the aquifer) situated at elevations of approximately 1 to 10 feet above mean sea level (MSL) [Refs. 10, pp. 3−4; 20, pp. 7, 12−13, 25, 27; 22, pp. 8, 51−52]. Depth to ground water at the site is 15.4 to 118 feet below ground surface (bgs) [Refs. 7, pp. 18−20, 26, 31; 10, pp. 3−4]. Ground water generally flows in a northerly direction toward the coast, with a smaller ground water flow component east toward the north-flowing Río de la Plata [Refs. 21, p. 18; 22, p. 52]. Karstification, seasonal fluctuations, drought conditions, ground water withdrawals, and development can create drawdown that affects the direction of ground water flow in the aquifer locally [Refs. 21, p. 18; 22, pp. 51−56]. Although the relatively impermeable part of the Cibao Formation generally forms the lower boundary of the aquifer, which limits vertical ground water flow, the freshwater−saltwater interface forms the aquifer’s effective lower boundary at and north of the site [Ref. 20, pp. 7, 11, 18, 25]. The freshwater lens in the NCLAS upper aquifer is estimated to be 200 to 300 feet thick at and in the vicinity of the site [Ref. 19, p. 12].

The Dorado region is characterized by karst topography, specifically, outcrops of the Aymamón Limestone known as mogotes. The mogotes commonly contain large holes at their bases, acting as channels that capture surface runoff and recharge the underlying limestone [Refs. 20, pp. 3, 10, 13; 21, pp. 11−15; 22, pp. 8−12, 31, 36, 51−52, 63]. The limestone units that make up the water-table aquifer exhibit typical karst characteristics, such as transmission of ground water through channel networks near the water table, decreasing permeability with increasing depth below the water table, zones of exceptionally high permeability in valleys, and a permeable and cavernous unsaturated zone [Refs. 20, pp. 3, 10, 13; 21, pp. 11−15; 22, pp. 8−12, 31, 36, 51−52, 63]. Hydraulic conductivity of the NCLAS upper aquifer is estimated to range from less than 1 meter per day (m/d; converts to 1.15 x $10^{-3}$ centimeters per second [cm/s]*) to more than 2,000 m/d (2.3 cm/s); the parts of the aquifer with hydraulic conductivities less than 30 m/d (3.45 x $10^{-2}$ cm/s) are considered the least permeable [Ref. 22, p. 61].

* Conversion: (1 m/d) x (100 cm/m) x (1/86,400 d/s) = 1.15 x $10^{-3}$ cm/s

**Stratum 1** (shallowest)

Stratum/Aquifer Name: NCLAS upper aquifer

Description:

In the Dorado area, the NCLAS upper aquifer is composed of the permeable parts of surficial unconsolidated deposits, the Aymamón Limestone, the Aguada Limestone, and the upper permeable parts of the Cibao Formation [Refs. 4, p. 1; 10, p. 47; 20, p. 11; 22, pp. 51−52]. These formations are in hydraulic connection in the area and are classified as a single hydrogeologic unit (i.e., the upper aquifer) [Refs. 19, pp. 4−5; 20, p. 11]. The unconsolidated deposits consist mainly of quartz sand and reddish-brown clay referred to collectively as blanket sands; the average thickness of these deposits is 4 to 10 meters (approximately 13 to 33 feet) [Ref. 20, p. 6]. There are also a variety of unconsolidated and semi-consolidated deposits adjacent to rivers and near the coast, including river-terrace deposits, deltaic and mud-flat deposits, beach deposits, eolianites, landslide debris, alluvium, swamp deposits, beach deposits, and reef deposits [Ref. 20, p. 6].

The Aymamón Limestone is thick-bedded to massive, very pure limestone; it is dolomitic near the coast and its thickness ranges from 190 to 330 meters (approximately 620 to 1,100 feet) [Refs. 21, p. 15; 22, pp. 30−31]. The Aguada Limestone consists of hard calcarenite alternating with chalky and rubbly limestone; the formation ranges in thickness from 60 to 175 meters (approximately 200 to 575 feet), and in many places the limestone is sandy [Refs. 21, p. 15; 22, p. 30]. In the area east of the Río Cibuco, which includes the location of Source 1 and surroundings, the Aguada Limestone is saturated and is in hydraulic connection with the underlying Cibao Formation and older carbonate units [Ref. 19 pp. 4−5]. The upper part of the Cibao Formation consists of beds of calcareous clay, earthy limestone, and marl indicative of its four members present in the Dorado region (i.e., upper member, Miranda Sand Member, Quebrada Arenas Limestone Member, and Río Indio Limestone Member) [Refs. 20, pp. 4−5; 21, pp. 14−15]. The thickness of the Cibao Formation ranges from 50 to 200 meters (approximately 160 to 660 feet); the relatively impermeable part of the formation forms the lower boundary of the upper aquifer [Ref. 20, pp. 4, 11].

## 3.1 LIKELIHOOD OF RELEASE

### 3.1.1 Observed Release

Aquifer Being Evaluated: NCLAS – upper aquifer

Multiple observed releases are documented for the Dorado Ground Water Contamination site. Chemical analyses for ground water samples collected from the active and inactive supply wells in September 2015 confirm the presence of hazardous substances in the aquifer [see "Chemical Analysis", below].

**Direct Observation**

The aquifer is not evaluated for observed release by direct observation.

**Chemical Analysis**

In September 2015, EPA collected ground water samples from five active water supply wells and eight inactive water supply wells owned by PRASA and from one commercial production well operated by a water bottling plant [Refs. 6, pp. 3−13, 18−32, 37; 7, pp. 3−6, 10, 18−31]. All samples consisted of raw water collected prior to any on-site treatment [Ref. 7, pp. 3−6]. The water bottling plant did not have a sampling spigot prior to its 2,000-gallon holding tank; therefore, the sample from that well (DGWC-GW08) was collected after passing through the storage tank, which has continuous flow-through [Ref. 7, pp. 4, 25]. The ground water samples were analyzed for Organic TAL VOCs (trace concentration) according to "EPA Contract Laboratory Program [CLP] Statement of Work for Organic Superfund Methods, Multi-Media, Multi-Concentration, SOM02.2", under CLP Case No. 45651 [Refs. 8, pp. 1−4, 74–79; 51, pp. 1–18; 52, pp. 1–15]. The quantitation limit reported for each result was the CRQL adjusted for sample and method [Ref. 8, pp. 3, 75]. Since the samples were analyzed through CLP, these adjusted CRQLs are used in place of the HRS-defined SQL [Ref. 1, Sections 1.1 and 2.3]. Chain-of-custody was maintained for the samples throughout collection, shipping, and analysis [Refs. 7, pp. 33−39, 41; 8, pp. 4−8; 51, pp. 2−4; 52, p. 2].

At each active well and inactive well with a functioning pump, Region 2 SAT collected raw ground water samples (i.e., prior to water treatment) from sampling spigots as close as possible to the wellhead; the well at the water bottling plant was sampled from a spigot after a water tank but before treatment [Refs. 6, pp. 8−13; 7, p. 4]. For those wells where electrical service has been disconnected, Region 2 SAT procured an electrical subcontractor to restore power to the pump [Refs. 6, pp. 10−12; 7, p. 4]. At each inactive well without a functioning pump, Region 2 SAT collected samples using ground water purging and sampling techniques, and included measuring the depth to ground water at each well. All wells with the exception of the water bottling plant were purged prior to sample collection, and water quality parameters (i.e., pH, specific conductance, temperature, and turbidity) were recorded [Refs. 6, pp. 5−8, 11−13; 7, pp. 4, 18−30]. For Quality Assurance/Quality Control (QA/QC) purposes, Region 2 SAT collected one environmental duplicate ground water sample, four trip blank samples to evaluate cross-contamination, and three rinsate blank samples to demonstrate adequate decontamination of the submersible pump [Refs. 6, pp. 6, 8, 9, 11, 19; 7, pp. 4, 6].

Bromodichloromethane, chloroform, cis-1,2-DCE, PCE, and TCE were each detected above the applicable CRQL (0.50 μg/L, adjusted for sample characteristics when necessary) in at least one ground water sample; individual concentrations ranged from 0.50 μg/L to 24 μg/L [Refs. 1, p. 51585−51586, 51589; 8, pp. 3, 56−64; 51, pp. 3−4, 98, 112−113, 124−125, 138, 178, 188−189, 200−201, 212−213, 225, 236−237, 247−248]. Wells at several locations surrounding the plume exhibited background concentrations for site-specific hazardous substances, including non-detect results for all five substances in the sample collected from the Vivoni well to the south [Refs. 7, pp. 6, 10; 8, pp. 3, 55−56, 64−65, 75, 161; 51, pp. 2, 4, 34−35, 48−49, 59−60, 259−260; 52, pp. 2, 32−33].

*Notes about background conditions and sample similarity*:
The chlorinated solvents found in the public supply wells are not naturally occurring [Refs. 11, p. 1; 13, p. 1]. PCE and TCE are man-made chlorinated solvents that are commonly used in commercial/industrial operations such as dry cleaning and metal degreasing; cis-1,2-DCE is used to make solvents and is a common breakdown product of PCE and TCE [Refs. 11, p. 1; 12, p. 1; 13, p. 1; 14, p. 16]. Chloroform is a common environmental contaminant

derived from various industrial and chemical processes, including as a byproduct of disinfecting water with chlorine [Refs. 15, p. 1; 16, p. 1]. A review of previous analytical results for the Maguayo wells indicates detections of chloroform [Refs. 17, p. 1; 30 through 50]. Bromodichloromethane is also a common byproduct of water chlorination [Ref. 18, p. 1].

For the site-specific samples, all background and contaminated samples documenting the observed release were collected from the hydrologic unit being evaluated (i.e., the NCLAS upper aquifer) [Ref. 10, pp. 1−27, 47−53, 85]. That is, the sampled wells, whether background or release, withdraw water from the formations that compose the aquifer (specifically, the Aymamón Limestone, Aguada Limestone, and Cibao Formation) at a similar range of screened interval elevations with respect to mean sea level (MSL) [Ref. 10, pp. 3−27, 30, 50−52, 62−63, 77−82, 85, 92]. In addition, the Vivoni well is located upgradient of all other wells and is screened in a similar relative position with respect to the top of the static water level (i.e., the water table); that is, the screened interval for the Vivoni well is 13 to 140 feet below the static water level, and the screened intervals for other background concentration wells and the release wells all fall within the range of 0 to 232 feet below the static water level [Figure 1; Refs. 4, p. 1; 10, pp. 3−27, 77-82; 21, p. 18; 22, p. 52]. The samples were all collected within a one-week period (September 22-28, 2015) during a single sampling event [Refs. 6, pp. 3−13; 7, pp. 6, 33−39].

Based on these considerations, the well samples exhibiting background concentrations are considered to be representative of background levels within the NCLAS upper aquifer, and are used for comparison to the release samples collected from the Dorado Urbano system, Maguayo system, and water bottling plant wells that exhibit contamination.

**Background Concentrations**

During the September 2015 sampling event, EPA collected ground water samples from the Dorado area wells, including the following wells that exhibited background concentrations [Refs. 6, pp. 5−6, 13, 19, 21−24, 32, 37; 7, pp. 3−6, 10, 18−19, 30−31, 37−38].

**TABLE 3. BACKGROUND SAMPLE INFORMATION**

| **Well Location** | **Ground Surface Elev. (ft MSL)** | **Screened Interval (ft MSL)** | **Sample ID/ CLP Sample No.** | **Sample Date** | **Reference(s)** |
|---|---|---|---|---|---|
| Dorado Dairy 2 | 50 | 3.47 to -150 | DGWC-GW01/ BCJQ1 | 09/22/2015 | 4, p. 1; 6, pp. 5, 21−22; 7, pp. 6, 10, 18; 10, pp. 3−4, 30, 77−78 |
| San Antonio 2 | 16.5 | -29.5 to -69.5 | DGWC-GW02/ BCJQ2 | 09/22/2015 | 4, p. 1; 6, pp. 6, 23−24; 7, pp. 6, 10, 19; 10, pp. 3−4, 25, 30 |
| | | | DGWC-GW19/ BCJR9 | 09/22/2015 | |
| Vivoni | 230 | 157 to 30 | DGWC-GW13/ BCJR3 | 09/25/2015 | 4, p. 1; 6, pp. 13, 32; 7, pp. 6, 10, 30; 10, pp. 3−4, 6, 27, 50−52 |
| Higuillar | 60 | unknown to -140 | DGWC-GW14/ BCJR4 | 09/28/2015 | 4, p. 1; 6, pp. 19, 37; 7, pp. 6, 10, 31; 10, pp. 3−4, 30, 62−63 |

ft MSL feet above/below mean sea level

| TABLE 4. BACKGROUND SAMPLE RESULTS | | | | |
|---|---|---|---|---|
| **Sample ID/ CLP Sample No.** | **Hazardous Substance** | **Level (µg/L)** | **CRQL (µg/L)** | **Reference(s)** |
| DGWC-GW01/ BCJQ1 | Bromodichloromethane | 0.50 U | 0.50 | 7, pp. 6, 18, 33−34; 8, pp. 2−10, 55; 51, pp. 2, 34−35 |
| | Chloroform | 0.50 U | 0.50 | |
| | cis-1,2-DCE | 0.50 U | 0.50 | |
| | PCE | 0.35 J | 0.50 | |
| | TCE | 0.15 J | 0.50 | |
| DGWC-GW02/ BCJQ2 | Bromodichloromethane | 0.50 U | 0.50 | 7, pp. 6, 19, 33−34; 8, pp. 2−8, 11−12, 55−56; 51, pp. 2, 48−49 |
| | Chloroform | 0.50 U | 0.50 | |
| | cis-1,2-DCE | 0.50 U | 0.50 | |
| | PCE | 0.23 J | 0.50 | |
| | TCE | 0.50 U | 0.50 | |
| DGWC-GW19/ BCJR9 | Bromodichloromethane | 0.50 U | 0.50 | 7, pp. 6, 19, 33−34; 8, pp. 2−8, 35−36, 65; 51, pp. 2, 59−60 |
| | Chloroform | 0.50 U | 0.50 | |
| | cis-1,2-DCE | 0.50 U | 0.50 | |
| | PCE | 0.24 J | 0.50 | |
| | TCE | 0.50 U | 0.50 | |
| DGWC-GW13/ BCJR3 | Bromodichloromethane | 0.50 U | 0.50 | 7, pp. 6, 30, 37−38; 8, pp. 2−8, 33−34, 64; 51, pp. 4, 259−260 |
| | Chloroform | 0.50 U | 0.50 | |
| | cis-1,2-DCE | 0.50 U | 0.50 | |
| | PCE | 0.50 U | 0.50 | |
| | TCE | 0.50 U | 0.50 | |
| DGWC-GW14/ BCJR4 | Bromodichloromethane | 0.50 U | 0.50 | 7, pp. 6, 31, 39, 41; 8, pp. 74−85, 161; 52, pp. 2, 32−33 |
| | Chloroform | 0.50 U | 0.50 | |
| | cis-1,2-DCE | 0.50 U | 0.50 | |
| | PCE | 0.50 U | 0.50 | |
| | TCE | 0.12 J | 0.50 | |

µg/L — micrograms per liter
CRQL — Contract-required quantitation limit, adjusted for sample and method [Ref. 8, pp. 3, 75]
U — Indicates that the analyte was analyzed for, but was not detected at a level greater than or equal to the level of the adjusted CRQL for sample and method [Ref. 8, p. 3].
J — The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample (due to the concentration of the analyte was below the CRQL) [Refs. 8, pp. 3, 75; 28, pp. 4−8].

**Contaminated Samples**

During the September 2015 sampling event, EPA collected ground water samples from the Dorado area wells, and the results confirmed the presence of bromodichloromethane; chloroform; cis-1,2- DCE; PCE; and TCE at concentrations significantly above background levels [Refs. 6, pp. 3−13, 21−32, 37; 7, pp. 3−6, 10, 18−41; 8, pp. 13−34, 56−65].

| TABLE 5. RELEASE SAMPLE INFORMATION | | | | | |
|---|---|---|---|---|---|
| **Well Location** | **Ground Surface Elev. (ft MSL)** | **Screened Interval (ft MSL)** | **Sample ID/ CLP Sample No.** | **Sample Date** | **Reference(s)** |
| San Antonio 3 | 16.5 | -29.5 to -69.5 | DGWC-GW03/ BCJQ3 | 09/23/2015 | 4, p. 1; 6, pp. 7, 24; 7, pp. 6, 10, 20; 10, pp. 3−4, 24, 30, 81−82 |
| Maguayo 7 | 25 | -55 to -115 | DGWC-GW04/ BCJQ4 | 09/23/2015 | 4, p. 1; 6, pp. 8, 25−26; 7, pp. 6, 10, 21; 10, pp. 3−4, 15−18, 30, 79−80, 85 |
| Maguayo 6 | 35 | -25 to -95 | DGWC-GW05/ BCJQ5 | 09/23/2015 | 4, p. 1; 6, pp. 8, 26; 7, pp. 6, 10, 22; 10, pp. 3−4, 11−14, 30, 79−80, 85 |
| Maguayo 2 | 121 | -49 to -229 | DGWC-GW06/ BCJQ6 | 09/23/2015 | 4, p. 1; 6, pp. 8, 27; 7, pp. 6, 10, 23; 10, pp. 3−4, 6, 30, 50−52 |
| Nevárez | 25 | -15 to -115 | DGWC-GW07/ BCJQ7 | 09/24/2015 | 4, p. 1; 6, pp. 9−10, 27−28; 7, pp. 6, 10, 24; 10, pp. 3−4, 19 |
| Water bottling plant | 60 | unknown to -240 | DGWC-GW08/ BCJQ8 | 09/24/2015 | 4, p. 1; 6, p. 11; 7, pp. 6, 10, 25; 10, pp. 3−4, 92−95 |
| Maguayo 4 | 95 | 30 to -65 | DGWC-GW09/ BCJQ9 | 09/24/2015 | 4, p. 1; 6, pp. 11−12, 28, 31; 7, pp. 6, 10, 26; 10, pp. 3−5, 30, 50−52 |
| Maguayo 3 | 98 | 18 to -62 | DGWC-GW10/ BCJR0 | 09/24/2015 | 4, p. 1; 6, pp. 11−12, 29−30; 7, pp. 6, 10, 27; 10, pp. 3−4, 7−10, 30, 50−52 |
| Santa Rosa | 35 | -25 to -70 | DGWC-GW11/ BCJR1 | 09/24/2015 | 4, p. 1; 6, pp. 11−12; 7, pp. 6, 10, 28; 10, pp. 3−4, 20−23, 30 |
| Maguayo 5 | 60 | unknown to -85 | DGWC-GW12/ BCJR2 | 09/24/2015 | 4, p. 1; 6, pp. 11−12, 31−32; 7, pp. 6, 10, 29; 10, pp. 3−4, 30, 79−80 |

ft MSL feet above/below mean sea level

**Contaminated Samples (continued)**

| TABLE 6. OBSERVED RELEASE SAMPLE RESULTS | | | | |
|---|---|---|---|---|
| **Sample ID/ CLP Sample No.** | **Hazardous Substance** | **Concentration (µg/L)** | **CRQL (µg/L)** | **Reference(s)** |
| DGWC-GW03/ BCJQ3 | TCE | **0.91** | 0.50 | 7, pp. 6, 35−36; 8, pp. 13, 56; 51, pp. 3, 98 |
| DGWC-GW04/ BCJQ4 | Chloroform | **7.9** | 0.50 | 7, pp. 6, 35−36; 8, pp. 15−16, 57; 51, pp. 3, 112−113 |
| | cis-1,2-DCE | **1.0** | 0.50 | |
| | PCE | **3.8** | 0.50 | |
| | TCE | **0.50** | 0.50 | |
| DGWC-GW05/ BCJQ5 | Chloroform | **11** | 0.50 | 7, pp. 6, 35−36; 8, pp. 17−18, 58; 51, pp. 3, 124−125 |
| | cis-1,2-DCE | **1.2** | 0.50 | |
| | PCE | **5.0** | 0.50 | |
| | TCE | **0.54** | 0.50 | |
| DGWC-GW06/ BCJQ6 | Bromodichloromethane | **7.9** | 0.50 | 7, pp. 6, 35−36; 8, pp. 3, 19−20, 59; 28, pp. 4−9, 12; 51, pp. 3, 138 |
| | PCE | **0.66 J-** | 0.50 | |
| DGWC-GW07/ BCJQ7 | PCE | **1.5** | 0.50 | 7, pp. 6, 37−38; 8, pp. 21−22, 60; 51, pp. 4, 178 |
| DGWC-GW08/ BCJQ8 | Chloroform | **13** | 0.50 | 7, pp. 6, 37−38; 8, pp. 23−24, 60; 51, pp. 4, 188−189 |
| | cis-1,2-DCE | **1.1** | 0.50 | |
| | PCE | **3.7** | 0.50 | |
| DGWC-GW09/ BCJQ9 | Chloroform | **13** | 0.50 | 7, pp. 6, 37−38; 8, pp. 25−26, 61; 51, pp. 4, 200−201 |
| | cis-1,2-DCE | **1.3** | 0.50 | |
| | PCE | **7.6** | 0.50 | |
| DGWC-GW10/ BCJR0 | Chloroform | **24** | 2.5 | 7, pp. 6, 37−38; 8, pp. 27−28, 62; 51, pp. 4, 212−213, 225 |
| | PCE | **2.9** | 0.50 | |
| DGWC-GW11/ BCJR1 | Chloroform | **1.9** | 0.50 | 7, pp. 6, 37−38; 8, pp. 29−30, 63; 51, pp. 4, 236−237 |
| | PCE | **1.2** | 0.50 | |
| DGWC-GW12/ BCJR2 | Chloroform | **18** | 0.50 | 7, pp. 6, 37−38; 8, pp. 31−32, 63−64; 51, pp. 4, 247−248 |
| | cis-1,2-DCE | **2.2** | 0.50 | |
| | PCE | **11** | 0.50 | |
| | TCE | **0.68** | 0.50 | |

µg/L  micrograms per liter
CRQL  Contract-required quantitation limit, adjusted for sample and method [Ref. 8, pp. 3, 75]
J-  The result is an estimated quantity that might be biased low. In accordance with the November 1996 EPA fact sheet "*Using Qualified Data to Document an Observed Release and Observed Contamination*", the value is usable without adjustment [Refs. 8, p. 3; 28, pp. 4−8].

<u>Hazardous Substances Released:</u>

| | |
|---|---|
| Bromodichloromethane | CAS No. 000075-27-4 |
| Chloroform | CAS No. 000067-66-3 |
| Cis-1,2-Dichloroethylene (cis-1,2-DCE) | CAS No. 000156-59-2 |
| Tetrachloroethylene (PCE) | CAS No. 000127-18-4 |
| Trichloroethylene (TCE) | CAS No. 000079-01-6 |

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Ground Water Observed Release Factor Value: 550

Attribution:

Due to the presence of multiple possible sources but no results for intervening areas, EPA has not yet identified a surface source of the ground water contaminants in the Dorado public supply wells. The site is located in a long-developed area where numerous possible source facilities have been identified [Refs. 24, pp. 1−15, 170; 25, pp. 3, 15; 26, pp. 10−15]. Although EPA has performed sampling investigations at numerous facilities in the area [see “Other Possible Sources” below], there are no intervening data to directly connect possible source facilities to the supply well contamination. The heterogeneous nature of the karst limestone aquifer makes it difficult to determine where contamination originates or contaminant flow paths [Refs. 20, pp. 13, 32; 22, pp. 49−52, 60−61]. PCE and TCE are man-made chlorinated solvents that are commonly used in commercial/industrial operations such as dry cleaning and metal degreasing; cis-1,2-DCE is used to make solvents and is a common breakdown product of PCE and TCE [Refs. 11, p. 1; 12, p. 1; 13, p. 1; 14, p. 16]. Chloroform is a common environmental contaminant derived from various industrial and chemical processes, including as a byproduct of disinfecting water with chlorine [Refs. 15, p. 1; 16, p. 1]. A review of previous analytical results for the Maguayo wells indicates detections of chloroform [Ref. 17, p. 1]. Bromodichloromethane is an industrial chemical that is also a common byproduct of water chlorination [Ref. 18, p. 1].

In July 2009, PRASA completed a Sanitary Survey, which included an inventory of possible sources of pollution within 1 mile of supply well Maguayo 3 [Ref. 25, pp. 1−2, 17]. The majority of the facilities identified were auto repair/body shops and gas stations south of the well along Route 2, some of which also contained junkyards where scrap cars and miscellaneous metal debris are stored [Ref. 25, pp. 3, 15, 18]. Information gathered during the survey indicates that scrap metal, solid wastes, and used oils generated at these facilities are collected for recycling [Ref. 25, pp. 3, 18]. Photographic documentation provided in the survey indicates poor housekeeping at some facilities [Ref. 25, pp. 5−13]. The survey also identified two horse farms just north and south of Maguayo 3 where wastes are discharged directly to the ground surface; however, the types of wastes were not identified [Ref. 25, pp. 3, 15, 18].

EPA has investigated facilities throughout Dorado in multiple attempts to identify the source(s) of the ground water contaminants, including sample collection at facilities within and around the area of observed ground water contamination. In 2008, EPA launched the Maguayo Site Discovery Initiative (SDI) as an effort to identify possible hazardous waste sites in the vicinity of the contaminated wells [Refs. 26, p. 3; 29, pp. 3−4]. After a sampling effort confirmed contamination in the Dorado area public supply wells, EPA conducted windshield surveys, file searches and reviews, and site reconnaissance activities to identify possible source facilities; based on these efforts, EPA identified 21 facilities for further investigation [Refs. 26, pp. 10−15, 144−170; 29, pp. 3−5, 28]. In 2011 and 2013, EPA conducted Preliminary Assessment/Site Inspections (PA/SI) at the 21 facilities; in 2015, Site Reassessments (SR) were conducted at five of the facilities. Surface soil samples, subsurface soil samples, and ground water samples (if ground water was encountered) were collected from each facility; soil gas samples were collected at one active dry-cleaning facility [Refs. 30 through 50; see “Other Possible Sources” below]. Analytical results documented the presence or apparent presence of chlorinated solvents at several facilities, while there were no detections at other facilities (see **Figure 2**). Although some of the possible sources are more than 1 mile from the contaminated wells, the Dorado region is underlain by a karst aquifer. Pumping of supply wells could affect ground water flow over areas large enough to capture contamination from one or more distant sources in several directions, but there are no intervening data to clearly connect any of the possible sources to the well contamination [Figure 2; Refs. 20, pp. 3, 10, 13; 21, pp. 11−15; 22, pp. 8−12, 31, 36, 51−52, 63].

EPA also identified other industrial facilities in the vicinity of the ground water contamination, including: In-Mar Trading (within the area of observed ground water contamination); Department of Agriculture Diagnostics Laboratory (0.1 mile east-northeast); Mapei Caribe, Dorado Electroplating, Gulbrandsen Puerto Rico Inc., Prisma Print, and El Viejo Metal Recycling (all located approximately 1 mile south); Hi-Class Cleaners (1.1 miles north); Boston Scientific (1.5 miles north); and Biovail Laboratories International SRL (1.7 miles north) [Figure 2; Ref. 29, pp. 11−22]. A review of environmental databases identified additional possible sources in the vicinity of the site, including in the neighboring municipalities of Toa Baja to the east and Vega Alta to the west [Ref. 24, p. 170]. Although there is this multitude of facilities in the region that are or could be associated with the site contaminants, there is not sufficient evidence (i.e., data for intervening areas) to attribute the ground water contamination in the public supply wells to any specific facility(ies); therefore, there is no identified source(s) of contamination [Figures 1 and 2; Ref. 1, pp. 51588, 51595]. **Figure 2** shows the locations of possible source facilities.

Other Possible Sources

During the course of the investigations in 2011, 2013, and 2015, EPA detected contaminants of possible concern (COPC) in soil and shallow ground water samples at and near several nearby facilities located within 2 miles of the area of observed ground water contamination [Figure 2; Refs. 30 through 50]. All of the facilities investigated by EPA in 2011, 2013, or 2015, as well as the results of the investigations, are described below:

**Higuillar Dry Cleaners [Ref. 30]**

Higuillar Dry Cleaners (HDC) (EPA ID No. PRN000206355) is a dry cleaning and laundry facility located within the area of observed ground water contamination. The business has been operating since 2004; previous use of the property was residential. The property contains a two-story building, with laundry and dry cleaning operations conducted within semi-enclosed rooms on the first floor and a residence on the second floor. A concrete-block septic tank, which protrudes approximately 1 foot above the ground surface on the northern side of the property, receives wastewaters from both the facility and the residence. In May 2011, EPA observed that the owner was installing a new discharge pipe from the building to the septic tank and that an open trench on the northern portion of the property was full of raw wastewater [Figure 2; Ref. 30, pp. 4−7].

In February 2015, EPA collected surface soil, subsurface soil, and ground water samples for VOC analysis from five boreholes advanced at the HDC property using direct-push technology. Analytical results show the presence of chloroform (max. soil: 10 µg/kg; max. ground water: non-detect); cis-1,2-DCE (max. soil: 170 J µg/kg; max. ground water: 1,000 µg/L); PCE (max. soil: 44 µg/kg; max. ground water: 380 µg/L); trans-1,2-DCE (max. soil: 3.6 J µg/kg; max. ground water: 17 µg/L); TCE (max. soil: 73 µg/kg; max. ground water: 330 µg/L); and vinyl chloride (max. soil: 150 µg/kg; max. ground water: 380 µg/L) [Ref. 30, pp. 17−23].

**Green Point Sign & Screen Printing [Ref. 31]**

Green Point Sign & Screen Printing (EPA ID No. PRN000206356) is a small print shop on residential land located within the area of observed ground water contamination. The 0.79-acre property also contains three occupied residential structures and a local bar; the print shop and residences/bar are connected to two separate on-site septic systems. Silk screen printing of T-shirts and ink plotting of large signs and billboards have taken place at the facility since the late 1990s. Chemicals used during operations include Tekmar Formula TS-3™ (a spot cleaning solution that contains up to 15% by weight PCE), H-7 (a degreaser), and 2-butoxyethyl acetate. The facility operator stated that waste inks and spent cleaning solutions are returned to the manufacturer for disposal. EPA has observed stressed vegetation and ink staining on the property. A USGS piezometer (ID: USGS 182548066164401 Piezometer Maguayo 2 Dorado, PR) lies south of the property; the piezometer is screened from 105 to 110 feet bgs [Figure 2; Ref. 31, pp. 3−6].

In March 2013, EPA collected soil samples for VOC analysis from on-site and off-site locations using direct-push technology, and ground water samples from the USGS piezometer near the south side of the property. Analytical results for all soil samples indicated non-detect values for environmental VOC parameters. The two ground water samples collected from the USGS piezometer indicated estimated concentrations of PCE (2.9 µg/L and 3.2 µg/L, respectively) and concentrations of chloroform (5.7 µg/L and 5.8 µg/L, respectively) [Ref. 31, pp. 13−17].

**PRIDCO Block No: L-439-0-97 [Ref. 32]**

The PRIDCO Block No: L-439-0-97 property (EPA ID No. PRN000206371) consists of 155 acres of vegetated, mostly undeveloped land located along the western edge of the area of observed ground water contamination. Karst features, such as limestone outcroppings and mogotes, are located on the periphery of the property. Available background information and historical aerial photos suggest that the property was used historically for agricultural purposes. After purchasing the property in 1998, PRIDCO conducted Phase II ESA soil sampling and installation of three on-site monitoring wells at the property in 1998 and 2002. Observations from the Phase II ESA identified evidence of dumping, the presence of inorganic analytes at concentrations above EPA Soil Screening Levels (SSL), and detections of TCE in the monitoring wells ranging from 1.5 µg/L to 13.1 µg/L. Development of the property for a warehousing facility began in 2015; improvements include two on-site retention ponds and a paved access road equipped with storm drains, street lighting, and fire hydrants [Figure 2; Ref. 32, pp. 4−7].

In February 2011, EPA collected surface and subsurface soil samples from 13 boreholes advanced throughout the property using direct-push technology. During pre-sampling activities, EPA observed on-site debris piles and discovered that soil fill had been brought to the property to level the grade for the proposed industrial park. Analytical results indicated the presence of arsenic, chromium, and other metals at concentrations significantly above background, with the highest concentration of arsenic (101 mg/kg) detected in a surface soil sample collected next to an on-site debris pile. The concentrations of arsenic exceed EPA SSLs for outdoor worker exposure and migration to ground water. In January 2015, EPA collected surface soil and subsurface soil samples for VOC analysis from direct-push boreholes co-located with the 13 boreholes advanced during the 2011 sampling event. Sample results indicate non-detect values for all environmental VOC parameters. Ground water was not encountered within 50 feet of the ground surface in either 2011 or 2015, and the former monitoring wells could not be located [Ref. 32, pp. 8, 19−38]

**Adriel Auto [Ref. 33]**

Adriel Auto (EPA ID No. PRR000019422) is a car dealership located approximately 0.8 mile south-southeast of the area of observed ground water contamination. Adriel Auto has been selling automobiles and performing general automotive maintenance and repair services at the property since the early 1980s; a used car dealership reportedly operated on the property prior to Adriel Auto. The on-site parking lot was built over an unnamed intermittent stream, which now flows through a culvert that exits out of the wall on the property's northern boundary. Chlorinated solvents are not currently used for degreasing at Adriel Auto; it is unknown if they were used in the past. Degreasing is conducted with commercially available citrus- and silicon/naphtha-based cleaners. An aboveground storage tank within secondary containment holds used oil and is located in the vehicle service area. There are two grease traps in the floor of the vehicle service area; overflow from the grease traps enters an overflow pipe that drains into one of two septic tanks located on the property. The operator reported that the grease traps are routinely emptied. During an on-site reconnaissance in 2009, EPA observed staining on the head of the overflow pipe [Figure 2; Ref. 33, pp. 3−6].

In February 2013, EPA collected soil and ground water samples for VOC analysis from on-site and off-site locations using direct-push technology. The sampling team observed petroleum-like odors and PID readings above background at depths greater than 8 feet in two boreholes (S04 and S06) advanced in the vicinity of the on-site septic tanks. A layer of light non-aqueous phase liquid (LNAPL), approximately 0.95 feet thick, was encountered on the water table at borehole S06; some of this brownish-black LNAPL was entrained in ground water sample 2026-GW06 from the borehole. Analytical results indicate that several VOCs were present in the soil and ground water samples from boreholes S04 and S06, including petroleum-related compounds (i.e., benzenes and xylenes) and solvents (i.e., acetone, 2-butanone, and estimated concentrations of cis-1,2-DCE) [Ref. 33, pp. 6, 15−21].

**Metal Machining Co., Inc [Ref. 34]**

Metal Machining Co. Inc (EPA ID No. PRR000012674) is located approximately 1 mile south of the area of observed ground water contamination. The facility consists of a single structure, which houses administrative offices, engineering offices, and a machine shop; it is situated at the base of a limestone hill (i.e., mogote). Runoff from the property flows to a sinkhole adjacent to the western boundary of the property and into a storm drain adjacent to the southern boundary. Operations consist of designing, fabricating, and installing custom machines and machine parts; machine shop equipment includes lathes, milling machines, grinders, and a welding area. Degreasing of metal parts is conducted over a self-contained sink using commercial degreasers; acetone is also used. Used cutting oils, solvents, and hydraulic fluids are reportedly transported off-site by a permitted transporter, whereas process waters and sewage are discharged to a septic system on the eastern side of the facility. Metal Machining Co. Inc. has been operating since the owners bought the property in 1999, prior to which the property was vacant for approximately 10 years. According to a Metal Machining representative, the facility was used to manufacture Coca-Cola flavoring prior to the nonoperational period [Figure 2; Ref. 34, pp. 3−6].

In March 2013, EPA collected soil samples for VOC and TAL Inorganics analyses from four on-site locations and one off-site location using direct-push technology. VOCs were not detected in any soil samples collected from either on-site or off-site locations. Inorganic analyses indicated the presence of cobalt, lead, manganese, and nickel at concentrations greater than three times background levels. The inorganic concentrations are below EPA SSLs appropriate to the facility, with the exception of nickel exceeding the migration to ground water SSL [Ref. 34, pp. 6, 14−20].

**Narvaez Cleaners and Tailoring [Ref. 35]**

Narvaez Cleaners and Tailoring (EPA ID No. PRN000206357) is a dry-cleaning facility located approximately 1.2 miles north of the area of observed ground water contamination. The facility consists of a two-story concrete storefront building and concrete parking lot located in a mixed commercial and residential area of downtown Dorado. Narvaez Cleaners and Tailoring has operated the facility since 2000, prior to which El Dorado Dry Cleaning operated out of the building. The dry cleaning facility occupies the first floor and the second floor is a vacant residential space. In August 2009, the facility operator informed EPA and provided evidence that two to three 55-gallon drums of PCE are consumed per year in one dry-cleaning machine, that the machine is emptied and cleaned once per year, and that the waste is drummed for disposal. EPA observed four drums labeled “Hazardous Waste” within the facility in August 2009 and drums of PCE within the facility in March 2013 [Figure 2; Ref. 35, pp. 3−6].

In March 2013, EPA collected soil samples from five boreholes advanced at and in the immediate vicinity of the facility using direct-push technology. EPA also collected two sub-slab soil vapor samples beneath the facility. Analytical results indicated the presence of cis-1,2- DCE at 6.0 µg/kg in soil sample 2024-S05 (depth: 6-6.5 ft bgs) and at estimated concentrations in two other soil samples, at depths of 10.5-11 ft bgs and 13.5-14 ft bgs. PCE and its degradation products (i.e., TCE; cis-1,2-DCE; trans-1,2-DCE; 1,1-DCE; and vinyl chloride) were detected at elevated levels in the sub-slab soil vapor samples. Several petroleum-related VOCs were also detected in the soil vapor samples. EPA returned to the facility in September 2015 to collect soil samples beneath the building. Analytical results from sub-slab locations beneath the cleaning room (i.e., Borehole 1) and the former drum storage area (i.e., Borehole 2) indicate the presence of PCE (max. 750 µg/kg), TCE (max. 62 µg/kg), cis-1,2-DCE (max. 49 µg/kg), trans-1,2-DCE (max. 6.2 µg/kg), and vinyl chloride (max. 7.3 µg/kg) [Ref. 35, pp. 14−18].

**Laundry Espinosa [Ref. 36]**

Laundry Espinosa (EPA ID No. PRN000206358) is an active dry cleaning and laundry facility located in a strip mall approximately 1.2 miles south-southwest of the area of observed ground water contamination. The facility building contains two units, with Laundry Espinosa in the northwest unit and an after-school tutoring center in the southeast unit. The building is built on a hillside, with the storefronts facing northeast at street level, and the basement doors facing southwest. The facility has been operating at the current location since the 1980s. A hydrocarbon-based solvent, Exxsol™ D40 fluid, is utilized by the business; it is unknown if the facility has historically used other materials such as PCE for dry cleaning operations. In August 2009, March 2011, and May 2011, no wastes were observed to be generated or stored, and no signs of spills or discharges were noted [Figure 2; Ref. 36, pp. 4−7].

In February 2015, EPA collected surface soil, subsurface soil, and ground water samples for VOC analysis from five boreholes advanced throughout the property using direct-push technology. Ground water was reached in three of five boreholes, at depths ranging from 28 to 36 feet. Analytical results indicated non-detect values or estimated values below the RDL for all VOC parameters, with the exception of chloroform at 29 micrograms per liter (µg/L) in one ground water sample. There was a single estimated concentration of PCE below the RDL in one surface soil sample [Ref. 36, pp. 16−19].

**PRIDCO Building No: T-0320-0-56 [Ref. 37]**

PRIDCO Building No: T-0320-0-56 (EPA ID No. PRN000206380) is currently occupied by Embos, Inc. (a.k.a. Puerto Rico Traction Tires), an inactive tire repair and retreading business that operated at the facility from 1964 until 2010. It is located approximately 1.2 miles northeast of the area of observed ground water contamination. Three septic tanks are located on the south side of the property, most of which is unpaved with piles of used tires and black patches of shredded tires scattered around. The facility was constructed by PRIDCO in the mid-1950s. According to PRIDCO records, the facility was occupied by EMT Fittings in 1960 and was sold to the current owner in January 2000. The current owner operated under the names America Boschetti Bitter, Embos, Inc., and Puerto Rico Traction Tires. The only environmental work known to be conducted is the removal and closure of a fuel oil UST in 1998. However, no post-excavation analytical data or other documentation regarding the integrity of the tank is included in the available closure report [Figure 2; Ref. 37, pp. 3−6].

In October 2010, EPA confirmed that the facility is an inactive tire repair and retreading facility during an on-site reconnaissance. No hazardous waste or obvious signs of contamination were observed on the exterior portions of the property. However, black patches of apparent shredded tires were observed scattered throughout the property during the subsequent sampling event. In February 2011, EPA collected surface soil, subsurface soil, and ground water samples from five boreholes advanced throughout the property using direct-push technology. The samples were analyzed for VOCs through the EPA CLP. The analytical results indicated low, estimated concentrations of ethylbenzene and o-xylene in one surface soil sample and low, estimated concentrations of toluene and xylenes in three ground water samples. Analytical results indicated non-detect values for remaining VOC parameters, including PCE and TCE, in the soil and ground water samples [Ref. 37, pp. 6, 13−17].

**PRIDCO Building No:S-0050-0-51 [Ref. 38]**

PRIDCO Building No: S-0050-0-51 (EPA ID No. PRN000206379) is currently occupied by a National Hardware business, which includes a lumber yard and home center. It is located approximately 1.3 miles northeast of the area of observed ground water contamination. The property contains two buildings: one houses the hardware store and the other features a gardening center and a bedding supply store. According to PRIDCO records, the facility was constructed in the early 1950s by PRIDCO and was sold to Hicker of Puerto Rico (HPR) in February 1980. However, available on-line databases do not have records of HPR's operations. In addition, no information is available in PRIDCO's files regarding previous facility occupants during their ownership of the property [Figure 2; Ref. 38, pp. 3−6].

In October 2010, EPA conducted an on-site reconnaissance at the property. Observations indicated that the facility includes a retail hardware store and lumber yard and that no hazardous waste is generated. No obvious signs of contamination were noted. In February 2011, EPA collected surface soil, subsurface soil, and ground water samples for VOC analysis from five boreholes advanced throughout the property using direct-push technology. Analytical results indicated non-detect values for all environmental VOC parameters [Ref. 38, pp. 3, 13−17].

**Former Narvaez Cleaners and Tailoring Facility [Ref. 39]**

Former Narvaez Cleaners and Tailoring Facility (EPA ID No. PRN008008773) was a retail/commercial dry cleaning business that operated for an unknown length of time in the Dorado del Mar shopping center, approximately 1.5 miles north of the area of observed ground water contamination. A Subway restaurant with drive-through is currently in operation at this location; a Goodyear automotive maintenance facility operates out of the northwest portion of the building; there is a vacant storefront between the two aforementioned businesses. Additional shops, including a dry cleaning business (i.e., 5 Asec Cleaners), are located within the Dorado Del Mar shopping center [Figure 2; Ref. 39, pp. 3−6].

In March 2013, EPA personnel collected soil and ground water samples for VOC analysis from seven boreholes advanced at and in the vicinity of the facility. Analytical results indicated the presence of vinyl chloride at 14 µg/kg and cis-1,2-DCE and trans-1,2-DCE at estimated concentrations in one soil sample collected at depth 8.5–9.0 feet bgs adjacent to the former dry-cleaning facility The detection of acetone and 2-butanone in the samples are considered to be an indication of lab contaminants [Ref. 39, pp. 13−18].

**Edward's Dry Cleaners Toa Baja [Ref. 40]**

The Edward's Dry Cleaners Toa Baja (EDCTB) facility (EPA ID No. PRN000206360) is a former dry cleaning and laundry facility located in a residential neighborhood in Toa Baja, approximately 1.8 miles east-northeast of the area of observed ground water contamination. The dry cleaner operated at the location from approximately September 2008 until sometime between 2011 and 2014; the facility is not known to have a prior history of industrial activity. In August 2009, EPA observed a 55-gallon drum of unused PCE at the facility. The facility lacked the required PREQB operating permits and no information was available to document proper disposal of PCE. In March 2011, cleaning operations were being conducted in an open-air concrete building. Drain pipes for the laundry discharged to the ground surface behind the building. EPA observed an open PCE drum in the driveway and detected a chemical odor. The property owner indicated that the PCE drum had just been cleaned on the driveway, but no other signs of spills or leaks were noted. In December 2014, the facility owner informed EPA that the facility had been shut down by PREQB due to lack of air quality permits required for operation of the on-site generator. Dry cleaning and laundry operations had ceased; the 55-gallon drum of PCE was not observed, nor was any other container of cleaning product observed [Figure 2; Ref. 40, pp. 4−7].

In February 2015, EPA collected surface soil, subsurface soil, and ground water samples for VOC analysis from three boreholes advanced throughout the property using direct-push technology and stainless-steel hand augers. Analytical results indicated chloroform at 7.1 µg/kg in one soil sample. All other results for COPCs in soil and ground water samples were non-detect [Ref. 40, pp. 15−19].

The following facilities investigated by EPA in 2011 or 2015 are located in the PRIDCO Dorado Industrial Park approximately 1.1 to 1.4 miles north of the area of observed ground water contamination. There appears to be one or more sources of contamination within the industrial park (see **Figure 2**):

**PRIDCO Lot Nos: L-107-2-64-16/18/19 [Ref. 41]**

PRIDCO Lot Nos: L-107-2-64-16/18/19 (EPA ID No. PRN000206382) contains a large industrial facility occupied by Fortex/Fortiflex (Fortiflex), which manufactures reinforced rubber pails and tubes, and Ballester Hermanos (BH), which operates a refrigerated warehouse and distribution center for frozen grocery products. The property was formerly owned by PRIDCO, which sold it to Ecolab in 1988; Ecolab is a provider of industrial and medical hygiene-related products and services. Fortiflex purchased the facility in 1999, and is classified as a CESQG under RCRA (ID No. PRR000016360). During an on-site reconnaissance by EPA in August 2009, spent lubricants were being stored in a 300-gallon AST with secondary containment (concrete basin) pending shipment off the property. The tank was full, and excess lubricants were stored in buckets adjacent to the tank; minor staining was observed. Degreasing in the manufacturing area was conducted using D4®, a commercial kerosene-based degreaser. EPA observed a 1,000-gallon AST without secondary containment on the north side of the facility; Fortiflex indicated that the tank was from Ecolab's operations and was not used by Fortiflex. EPA also observed a former waste storage area used by Ecolab in the southeastern corner of the property; the area consisted of a fenced, concrete pad covered by a roof. In October 2010, EPA observed that conditions had changed significantly since the 2009 inspection. The open, grassy area on the east side of the property was now occupied by BH's refrigerated warehouse and distribution center; the 1,000-gallon AST had been removed; and the former waste storage area had been removed and paved over [Figure 2; Ref. 41, pp. 3−6].

In February 2011, EPA collected surface soil, subsurface soil, and ground water samples for VOC analysis from five boreholes advanced throughout the property using direct-push technology. Analytical results indicated the presence of a low, estimated concentration of dichlorodifluoromethane (Freon 12) in a surface soil sample collected near the refrigerated warehouse and distribution center; a low, estimated concentration of carbon disulfide in a surface soil sample collected near the former location of the waste storage area; and low, estimated concentrations of carbon disulfide in ground water samples collected from a borehole advanced east of the warehouse. Neither PCE nor TCE was detected in any of the soil or ground water samples collected from the property [Ref. 41, pp. 15−19].

**PRIDCO Building No. T-1125-0-73 and T-1125-1-79 [Ref. 42]**

PRIDCO Building No. T-1125-0-73 and T-1125-1-79 (EPA ID No. PRN000206385) is a light industrial facility owned by PRIDCO and located approximately 1.1 miles north of the area of observed ground water contamination. The facility was built in the 1970s to early 1980s. Information obtained from PRIDCO indicates that Five Star Products, Inc. used the facility to manufacture costume jewelry from 1974 to 1993. In 1979, Five Star disclosed that TCE was used at the facility as a degreaser. Five Star was assigned RCRA Handler ID No. PRD987372919. During its operations, Five Star operated an on-site wastewater treatment system; raw wastewaters were collected and discharged from the facility via a floor trench collection system to a pair of 500-gallon sumps, pending pH adjustment and transfer to additional treatment tanks. From 1994 to approximately 2008, the facility was occupied by Ecolab, a provider of industrial and medical hygiene-related products and services; there is no known hazardous waste activity related to Ecolab's operations at the facility. The facility is currently occupied by ProMed, which manufactures molded silicone and plastic components for medical implants; ProMed uses only small amounts of heptanes and alcohols in its manufacturing processes; chlorinated solvents are not used [Figure 2; Ref. 42, pp. 3−6].

In February 2011, WESTON collected surface soil, subsurface soil, and ground water samples for VOC analysis from direct-push boreholes advanced along the perimeter of the building and within the rear warehouse technology. Analytical results indicate the presence of vinyl chloride in the soil and ground water samples. Vinyl chloride was detected in a soil sample (9.9 µg/kg) and in four ground water samples (5.1 µg/L, 2.1 J µg/L, 2.1 J µg/L, and 1.4 J µg/L) [Ref. 42, pp. 13−20].

**PRIDCO Building No: S-0745-0-66 [Ref. 43]**

PRIDCO Building No: S-0745-0-66 (EPA ID No. PRN000206381) is a light industrial property located approximately 1.2 miles north of the area of observed ground water contamination. The facility was constructed in the mid-1960s. Information obtained from PRIDCO indicates that the facility was occupied by Claxbox of PR, Inc. (Claxbox) from 1982 to 1984 and Dorado Carton Co., Inc. (DCC) from 1993 to 2001; both companies manufactured boxes and crates. In July 2008, EPA observed a sign indicating that the facility was formerly occupied by Advanced Windows. A review of EPA on-line databases did not reveal any information regarding hazardous waste activity for Advanced Windows. Available information in 2011 indicated that the facility was leased to the Municipality of Dorado and slated to be used as an emergency response center; however, the property was vacant during EPA on-site sampling in 2011 [Figure 2; Ref. 43, pp. 3−6].

In February 2011, EPA collected surface soil, subsurface soil, and ground water samples for VOC analysis from five boreholes advanced throughout the property using direct-push technology. Analytical results indicated non-detect values for all environmental VOC parameters for the soil and ground water samples [Ref. 43, pp. 13−17].

**PRIDCO Buildings No: S-1166-0-74 and S-1166-0-80 [Ref. 44]**

PRIDCO Buildings No: S-1166-0-74 and S-1166-0-80 (EPA ID No. PRN000206383) is an inactive, light industrial facility owned by PRIDCO and located approximately 1.2 miles north of the area of observed ground water contamination. The original portion of the facility (S-1166-0-74) was built in 1975, and building extension S-1166-0-80 was built in the early 1980s. PRIDCO records indicate that the facility was occupied by Economic Laboratories (July 1974 - June 1989), which manufactured detergent dispensers using plastic injection molding; M.A. International Manufacturing (early 1990s), which likely used the facility for manufacturing plastic components for industry; Ecolab Manufacturing (April 1994 - September 1994), which manufactured industrial hygiene equipment; Harvey Hubbell Caribe, Inc. (March 1995 - October 2000), which manufactured electrical components; and Omega Systems (unknown date to September 2008), which manufactured plastic water tanks. Harvey Hubbell Caribe, Inc. was assigned RCRA ID No. PRR000007104 and generated the following wastes: isopropanol, zinc compounds, and spent fluorescent light bulbs [Figure 2; Ref. 44, pp. 3−6].

From 2009 to 2011, EPA observed the property to be in a state of disrepair. On February 18, 2011, EPA personnel collected surface soil, subsurface soil, and ground water samples for VOC analysis from six boreholes advanced throughout the property using direct-push technology. With the exception of estimated concentrations of styrene (0.6 J µg/kg) and m, p-xylene (0.2 J µg/kg) in two surface soil samples, soil and ground water sample analytical results indicated non-detect values for all environmental VOC parameters [Ref. 44, pp. 3, 6, 13−18].

**PRIDCO Building No. T-1322-0-88 [Ref. 45]**

PRIDCO Building No. T-1322-0-88 (EPA ID No. PRN000206384) is an active, light industrial facility owned by PRIDCO and located approximately 1.2 miles north of the area of observed ground water contamination. Information obtained from PRIDCO indicates that the facility was constructed in 1981 and was occupied by Playtex Dorado from 1981 to approximately 2003. Playtex Dorado used the facility for the manufacture of women’s undergarments. Additional information provided by PRIDCO indicates that the facility was occupied by Provimi de Puerto Rico (Provimi) during an unknown time period; Provimi conducted meat processing and packaging [Figure 2; Ref. 45, pp. 3−6].

In August 2009 and October 2010, EPA observed the facility to be inactive and in a state of disrepair. In February 2011, EPA collected surface soil, subsurface soil, and ground water samples for VOC analysis from six boreholes advanced throughout the property using direct-push technology. Soil sample analytical results indicated non-detect values for all environmental VOC parameters. With the exception of one detection of 1,1-DCE at an estimated concentration below the SQL, ground water analytical results indicated non-detect values for all environmental VOC parameters. At the time of the sampling event, the facility was in the process of being renovated for Provimi to reoccupy the facility and resume meat processing and packaging operations in January 2012; Provimi did not anticipate generating hazardous waste as part of its business operations [Ref. 45, pp. 3, 6, 13−18].

**PRIDCO Buildings No: T-0638-0-66 and T-0638-1-67 [Ref. 46]**

PRIDCO Buildings No: T-0638-0-66 and T-0638-1-67 (EPA ID No. PRN000206375) is a light industrial property owned by PRIDCO and located approximately 1.2 miles north of the area of observed ground water contamination. PRIDCO records indicate that Newell manufactured metal wire products at the facility from 1967 to 1984; PRWRA occupied the facility from 1984 to 1985 (no information is available regarding PRWRA's operations); Playtex manufactured women's undergarments and used 1,1,1-TCA and naphtha-based solvents in the process from 1985 to 1994; and Omega manufactured plastic tanks from 1997 to 2002. The facility is currently occupied by Heraeus (a.k.a. Synosis Caribe; a.k.a. Heraeus Materials Caribe), which manufactures and assembles electrical coils and wires for medical devices such as pacemakers. The electrical components manufactured by Heraeus are cleaned in acid and alkaline baths using hydrochloric acid and hydrogen phosphate solutions, respectively; chlorinated solvents are not used. Spent acid and alkaline solutions are neutralized on-site in an evaporation unit. Products are polished using sodium and potassium salts, which are stored as non-hazardous waste in the storage shed pending shipment off the property. Small amounts of isopropyl alcohol and glycol are also used in the manufacturing process. Heraeus is classified as an SQG under RCRA (ID No. PRR000017202) [Figure 2; Ref. 46, pp. 4−7].

In January 2015, EPA collected surface soil, subsurface soil, and ground water samples for VOC analysis from six boreholes advanced throughout the property using direct-push technology. Analytical results indicated non-detect values for all chlorinated VOC parameters of concern for all soil and ground water samples, with the exception of chloroform detected at an estimated concentration of 0.74 J µg/kg in one soil sample [Ref. 46, pp. 16−21].

**PRIDCO Buildings # T-0957-0-68/ T-0957-1-71/T-0957-2-72/T-1053-0-73/T-1053-1-90 [Ref. 47]**

PRIDCO Buildings # T-0957-0-68/T-0957-1-71/T-0957-2-72/T-1053-0-73/T-1053-1-90 (EPA ID No. PRN000206372) is an inactive light industrial facility owned by PRIDCO and located approximately 1.3 miles north of the area of observed ground water contamination. The facility consists of two buildings constructed in the late 1960s and early 1970s, with an addition in the early 1990s; Emerson occupied both buildings from an unknown date until 2006 or 2007. Emerson manufactured electrical components for residential and commercial environmental controls, including mercury-containing thermostats and semiconductors. Emerson used 1,1,1-TCA, dichloromethane, lead, mercury, and xylenes in its operations, and the facility was classified as a RCRA CESQG (ID No. PRD090066234). The rear facility has been vacant since Emerson left in 2007; the front facility was occupied by Impresos Quintana, a commercial printing business that specialized in brochures, stationery, and business cards, from 2008 to 2010. In September 2009 and October 2010, EPA observed that the computer-assisted printing machines used at the facility were cleaned with water-based cleaners and commercial alcohol substitute cleaners, that there was no silk screening or use of chlorinated solvents, and that the facility was clean and well-maintained. Impresos Quintana was in the process of shutting down operations and vacating the facility in October 2010 [Figure 2; Ref. 47, pp. 3−6].

In February 2011, EPA collected surface soil, subsurface soil, and ground water samples for VOC analysis from eight boreholes advanced throughout the property using direct-push technology. Analytical results indicated the presence of low, estimated concentration of PCE and TCE in subsurface soil and ground water samples [Ref. 47, pp. 13−18].

**PRIDCO Building Nos: S-0838-0-67 and T-0998-0-74 [Ref. 48] and Former Edward's Dry Cleaners Facility Dorado [Ref. 49]**

PRIDCO Building Nos: S-0838-0-67 and T-0998-0-74 (EPA ID No. PRN000206373) is a former light industrial property that has been redeveloped into commercial properties. It is located in downtown Dorado, approximately 1.3 miles north of the area of observed ground water contamination. The PRIDCO-owned buildings formerly located on the property were built in the late 1960s to mid-1970s; PRIDCO sold the two buildings to Emulex in February 1984. Emulex manufactured data communication equipment, including computer-printed circuit boards, under RCRA ID No. PRD071807408, ceasing its Puerto Rico operations in 1998. The subject property is currently divided into two separately-owned commercial properties: the southern portion (former location of PRIDCO Building No. S-0838-0-67) is occupied by a CVS pharmacy; the northern portion (former location of PRIDCO Building No. T-0998-0-74) is occupied by part of the Mahi-Mahi Shopping Village, a strip mall with various retail businesses including restaurants, eye care, a paint store, and a salon [Figure 2; Ref. 48, pp. 3−6]. The Mahi-Mahi Shopping Village, Location # 6 is the location of Former Edward's Dry Cleaners Facility Dorado, where PCE-based dry cleaning was conducted from approximately 2005 to 2008 [Ref. 49, pp. 3−6].

In February 2011, EPA collected surface soil, subsurface soil, and ground water samples for VOC analysis from eight boreholes advanced throughout the property using direct-push technology. With the exception of one detection of cis-1,2-DCE at an estimated concentration (1.6 J µg/kg) in a subsurface soil sample, soil and ground water sample analytical results indicated non-detect values for all environmental VOC parameters excluding common laboratory contaminants such as acetone [Ref. 48, pp. 15−20].

**PRIDCO Building Nos: T-0868-0-67 and T-0868-1-69 [Ref. 50]**

PRIDCO Building Nos: T-0868-0-67 and T-0868-1-69 (EPA ID No. PRN000206374) is a former light industrial property located approximately 1.4 miles north of the area of observed ground water contamination. During PRIDCO's ownership, the facility consisted of one building constructed in the late 1960s and early 1970s. Information obtained from PRIDCO indicates that it was sold to Centronics, a manufacturer of computer printers, in February 1977. The Centronics facility was assigned RCRA ID No. PRD090525866, but generator status and hazardous waste information are not listed in the RCRA database. The property is currently occupied by a Walgreens pharmacy within the Mahi-Mahi Shopping Village, a retail shopping center, and it is owned by IGI, a commercial property management company [Figure 2; Ref. 50, pp. 3−6].

In February 2011, EPA collected surface soil, subsurface soil, and ground water samples for VOC analysis from four boreholes advanced throughout the property using direct-push technology. Soil sample analytical results indicated non-detect values for all VOC parameters. However, ground water sample analytical results indicated the presence of TCE, 1,1-DCE, cis-1,2-DCE, and 1,1,2-trichloro-1,2,2-trifluoroethane [Ref. 50, pp. 13−17].

## 3.2 WASTE CHARACTERISTICS

### 3.2.1 Toxicity/Mobility

| TABLE 7. TOXICITY/MOBILITY | | | | | |
|---|---|---|---|---|---|
| **Hazardous Substance** | **Source Numbers** | **Toxicity Factor Value** | **Mobility Factor Value** | **Toxicity/ Mobility** | **Reference(s)** |
| Bromodichloromethane | 1, OR | 100 | 1.0 | 100 | 2, p. 1 |
| Chloroform | 1, OR | 100 | 1.0 | 100 | 2, p. 2 |
| cis-1,2-Dichloroethylene | 1, OR | 1,000 | 1.0 | 1,000 | 2, p. 3 |
| Tetrachloroethylene | 1, OR | 100 | 1.0* | 100 | 2, p. 4 |
| Trichloroethylene | 1, OR | 1,000 | 1.0 | 1,000 | 2, p. 5 |

OR = Observed Release
* Karst value is used due to karst aquifer being evaluated (see **Section 3.0.1**).

### 3.2.2 Hazardous Waste Quantity

| TABLE 8. HAZARDOUS WASTE QUANTITY – GROUND WATER PATHWAY | | |
|---|---|---|
| **Source Number** | **Source Hazardous Waste Quantity (HWQ) Value (Section 2.4.2.1.5)** | **Is source hazardous constituent quantity data complete? (yes/no)** |
| 1 | >0 | No |
| | | |
| Sum of Values: | 1 (rounded to 1 as specified in HRS Section 2.4.2.2) | |

The sum corresponds to a hazardous waste quantity factor value of 1 in Table 2-6 of the HRS [Ref. 1, p. 51591]. However, based on the fact that targets are subject to Level I concentrations (see **Section 3.3.2.3**), a hazardous waste quantity factor value of 100 is assigned if it is greater than the hazardous waste quantity value from Table 2-6 of the HRS (i.e., 1) [Ref. 1, pp 51591-51592]. Therefore, a hazardous waste quantity factor value of 100 is assigned for the ground water pathway [Ref. 1, pp 51591-51592].

Hazardous Waste Quantity Factor Value: 100

### 3.2.3 Waste Characteristics Factor Category Value

Cis-1,2-dichloroethylene and trichloroethylene correspond to the toxicity/mobility factor value of 1,000, as shown previously (see **Section 3.2.1**).

Toxicity/Mobility Factor Value (1,000) x Hazardous
Waste Quantity Factor Value (100): $1 \times 10^5$

The product ($1 \times 10^5$) corresponds to a Waste Characteristics Factor Category Value of 18 in Table 2-7 of the HRS [Ref. 1, p. 51592].

==========================================================================

Waste Characteristics Factor Category Value: 18

## 3.3 TARGETS

Note: Populations are apportioned only to the active wells within the ground water plume; the consideration of inactive wells as standby wells and subsequent population apportionment would not increase the site score. However, it should be noted that PRASA has raised the possibility of reactivating some wells.

The Maguayo water supply system consists of three active wells (i.e., Maguayo 2, Maguayo 6, and Maguayo 7) and one surface water source (i.e., the super aqueduct) contributing to a blended system that serves a population of 36,630 [Ref. 10, pp. 1−98]. No single component contributes more than 40 percent of the total system production, so the system population is apportioned equally among the active system components (i.e., each active well is apportioned a population of 9,157.5 people) [Refs. 1, p. 51603; 10, pp. 1−4, 37−40]. The Dorado Urbano water supply system consists of two active wells (i.e., Santa Rosa and Nevárez) and one surface water source ((i.e., the super aqueduct) contributing to a blended system that serves a population of 31,061 people [Ref. 10, pp. 2−4, 32, 38, 96]. The super aqueduct contributes greater than 70% of the total system production, and the active Santa Rosa and Nevarez wells contribute less than 15% each [Ref. 10, pp. 32, 38]. The apportioned populations and levels of contamination are presented below:

**TABLE 9. TARGETS – GROUND WATER PATHWAY**

| Well | Distance from Source (mi.)* | Population | Level I Conc. (Y/N)** | Level II Conc. (Y/N)** | Potential Contam. (Y/N) | Reference(s) |
|---|---|---|---|---|---|---|
| Maguayo 2 | 1.5 | 9,157.5 | Y | Y | N | 10, pp. 4, 32 |
| Maguayo 3 | 1.3 | 0 – inactive | Y | Y | N | 10, pp. 4, 32 |
| Maguayo 4 | 0.9 | 0 – inactive | Y | Y | N | 10, pp. 4, 32 |
| Maguayo 5 | 0.6 | 0 – inactive | Y | Y | N | 10, pp. 4, 32 |
| Maguayo 6 | 0.1 | 9,157.5 | Y | Y | N | 10, pp. 4, 32 |
| Maguayo 7 | 0.1 | 9,157.5 | Y | Y | N | 10, pp. 4, 32 |
| Nevárez | 1.0 | 4,538.01 | N | Y | N | 10, pp. 4, 38 |
| Santa Rosa | 0.9 | 4,643.62 | N | Y | N | 10, pp. 4, 38 |
| San Antonio 3 | 1.1 | 0 – inactive | N | Y | N | 10, pp. 4, 38 |
| Water bottling plant | 0.4 | N/A – purified, packaged water and ice | Y | Y | N | 10, pp. 4, 96–97 |

* Distance is measured from the approximate center of the area of observed ground water contamination (see **Figure 1**).

** See **Table 6** for analytical results by ground water sample; see **Table 5** for sample locations/well names by sample ID. Maximum Contaminant Level Goals (MCLG) greater than 0, Maximum Contaminant Levels (MCL), Cancer Risk Screening Concentrations (CRSC), and Noncancer Risk Screening Concentrations (NRSC) are used as benchmarks to evaluate the level of contamination for the ground water migration pathway [Refs. 1, p. 51593, Section 2.5.2; 2, pp. 1−5].

Applicable benchmarks for the hazardous substances detected in the observed release are as follows (benchmarks are presented in µg/L for consistency with reported data; **boldface type** denotes the lowest applicable benchmark concentration for each hazardous substance):

**TABLE 10. HRS BENCHMARKS – GROUND WATER PATHWAY**

| Substance | MCLG (µg/L) | MCL (µg/L) | CRSC (µg/L) | NRSC (µg/L) | Reference(s) |
|---|---|---|---|---|---|
| Bromodichloromethane | --- | --- | **1.0** | 300 | 2, p. 1 |
| Chloroform | --- | --- | **2.1** | 100 | 2, p. 2 |
| cis-1,2-DCE | 70 | 70 | --- | **30** | 2, p. 3 |
| PCE | --- | **5** | 32 | 90 | 2, p. 4 |
| TCE | --- | 5 | **1.0** | 7 | 2, p. 5 |

| TABLE 11. LEVEL I CONCENTRATIONS | | | | | |
|---|---|---|---|---|---|
| **Well** | **Sample** | **Substance** | **Conc. (µg/L)** | **Benchmark (µg/L)** | **Reference(s)** |
| Maguayo 2 | DGWC-GW06/ BCJQ6 | Bromodichloromethane | **7.9** | 1.0 (CRSC) | 2, pp. 1−2; 7, p. 6; 8, pp. 19, 59; 51, pp. 3, 138 |
| Maguayo 3 | DGWC-GW10/ BCJR0 | Chloroform | **24** | 2.1 (CRSC) | 2, p. 2; 7, p. 6; 8, pp. 27, 62; 51, pp. 4, 212−213, 225 |
| Maguayo 4 | DGWC-GW09/ BCJQ9 | Chloroform | **13** | 2.1 (CRSC) | 2, pp. 2, 4; 7, p. 6; 8, pp. 25−26, 61; 51, pp. 4, 200−201 |
| | | PCE | **7.6** | 5 (MCL) | |
| Maguayo 5 | DGWC-GW12/ BCJR2 | Chloroform | **18** | 2.1 (CRSC) | 2, pp. 2, 4; 7, p. 6; 8, pp. 31−32, 63−64; 51, pp. 4, 247−248 |
| | | PCE | **11** | 5 (MCL) | |
| Maguayo 6 | DGWC-GW05/ BCJQ5 | Chloroform | **11** | 2.1 (CRSC) | 2, pp. 2, 4; 7, p. 6; 8, pp. 17−18, 58; 51, pp. 3, 124−125 |
| | | PCE | **5.0** | 5 (MCL) | |
| Maguayo 7 | DGWC-GW04/ BCJQ4 | Chloroform | **7.9** | 2.1 (CRSC) | 2, p. 2; 7, p. 6; 8, pp. 15, 57; 51, pp. 3, 112−113 |
| Water bottling plant | DGWC-GW08/ BCJQ8 | Chloroform | **13** | 2.1 (CRSC) | 2, p. 2; 7, p. 6; 8, pp. 23, 60; 51, pp. 4, 188−189 |

| TABLE 12. LEVEL II CONCENTRATIONS | | | | | |
|---|---|---|---|---|---|
| **Well** | **Sample** | **Substance** | **Conc. (µg/L)** | **Benchmark (µg/L)** | **Reference(s)** |
| Maguayo 2 | DGWC-GW06/ BCJQ6 | PCE | 0.66 J- | 5 (MCL) | 2, p. 4; 7, p. 6; 8, pp. 3, 19–20, 59; 51, pp. 3, 138 |
| Maguayo 3 | DGWC-GW10/ BCJR0 | PCE | 2.9 | 5 (MCL) | 2, p. 4; 7, p. 6; 8, pp. 27–28, 62; 51, pp. 3, 212−213, 225 |
| Maguayo 4 | DGWC-GW09/ BCJQ9 | Cis-1,2-DCE | 1.3 | 30 (RDSC) | 2, p. 3; 7, p. 6; 8, pp. 25, 61; 51, pp. 4, 200−201 |
| Maguayo 5 | DGWC-GW12/ BCJR2 | Cis-1,2-DCE | 2.2 | 30 (RDSC) | 2, pp. 3, 5; 7, p. 6; 8, pp. 31, 63; 51, pp. 4, 247−248 |
| | | TCE | 0.68 | 1.0 (CRSC) | |
| Maguayo 6 | DGWC-GW05/ BCJQ5 | Cis-1,2-DCE | 1.2 | 30 (RDSC) | 2, pp. 3, 5; 7, p. 6; 8, pp. 17, 58; 51, pp. 3, 124−125 |
| | | TCE | 0.54 | 1.0 (CRSC) | |
| Maguayo 7 | DGWC-GW04/ BCJQ4 | Cis-1,2-DCE | 1.0 | 30 (RDSC) | 2, pp. 3−5; 7, p. 6; 8, pp. 15−16, 57; 51, pp. 3, 112−113 |
| | | PCE | 3.8 | 5 (MCL) | |
| | | TCE | 0.50 | 1.0 (CRSC) | |
| Nevárez | DGWC-GW07/ BCJQ7 | PCE | 1.5 | 5 (MCL) | 2, p. 4; 7, p. 6; 8, pp. 21–22, 60; 51, pp. 4, 178 |
| Santa Rosa | DGWC-GW11/ BCJR1 | Chloroform | 1.9 | 2.1 (CRSC) | 2, pp. 2, 4; 8, pp. 29−30, 63; 51, pp. 4, 236−237 |
| | | PCE | 1.2 | 5 (MCL) | |
| San Antonio 3 | DGWC-GW03/ BCJQ3 | TCE | 0.91 | 1.0 (CRSC) | 2, p. 5; 7, p. 6; 8, pp. 13, 56; 51, pp. 3, 98 |
| Water bottling plant | DGWC-GW08/ BCJQ8 | Cis-1,2-DCE | 1.1 | 30 (RDSC) | 2, pp. 3−4; 7, p. 6; 8, pp. 23−24, 60; 51, pp. 4, 188−189 |
| | | PCE | 3.7 | 5 (MCL) | |

**3.3.1 Nearest Well**

As identified in **Section 3.3**, the active drinking water wells Maguayo 2, Maguayo 6, and Maguayo 7 are subject to Level I concentrations. Therefore, a nearest well factor value of 50 is assigned [Ref. 1, pp. 51602, 51603].

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Nearest Well Factor Value: 50

**3.3.2 Population**

**3.3.2.2 Level I Concentrations**

As identified in **Section 3.3**, three active drinking water wells (Maguayo 2, Maguayo 6, and Maguayo 7) are subject to Level I concentrations. The populations assigned to the wells are also explained in **Section 3.3**.

| **TABLE 13. LEVEL I POPULATIONS** | | |
|---|---|---|
| **Level I Well** | **Population** | **Reference(s)** |
| Maguayo 2 | 9,157.5 | 10, pp. 37−40, 96 |
| Maguayo 6 | 9,157.5 | 10, pp. 37−40, 96 |
| Maguayo 7 | 9,157.5 | 10, pp. 37−40, 96 |

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Population Served by Level I Wells: 27,472.5 Level I Concentrations Factor Value: 274,725

**3.3.2.3 Level II Concentrations**

As identified in **Section 3.3**, two active drinking water wells (Nevárez and Santa Rosa) are subject to Level II concentrations. The populations assigned to the wells are also explained in **Section 3.3**.

| **TABLE 14. LEVEL II POPULATIONS** | | |
|---|---|---|
| **Level II Well** | **Population** | **Reference(s)** |
| Nevárez | 4,538.01 | 10, pp. 32. 38, 96 |
| Santa Rosa | 4,643.62 | 10, pp. 32. 38, 96 |

==================================================================================

Population Served by Level II Wells: 9,181.63 Level II Concentrations Factor Value: 9,181.63

**3.3.2.4 Potential Contamination**

The aquifer being evaluated (i.e., the NCLAS upper aquifer) is the principal source of fresh ground water in Dorado and historically has been the principal source of public-supply and industrial water use in the region [Refs. 19, pp. 1−5; 20, pp. 1−7; 21, pp. 11−18]. Although there is no known active ground water use for drinking water in Toa Baja or Toa Alta, the municipalities to the east and south of Dorado, respectively, there is ground water use for drinking water in the municipality of Vega Alta less than 4 miles to the west [Refs. 4, p. 1; 30, p. 157; 53, pp. 1−4, 7, 10]. However, since Level I and Level II concentrations result in a maximum score of 100.00 for the ground water migration pathway, the Potential Contamination Factor Value was not scored.

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Potential Contamination Factor Value: NS

### 3.3.3 Resources

Since Level I and Level II concentrations result in a maximum score of 100.00 for the ground water migration pathway, the Resources Factor Value was not scored.

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Resources Factor Value: NS

### 3.3.4 Wellhead Protection Area

Since Level I and Level II concentrations result in a maximum score of 100.00 for the ground water migration pathway, the Wellhead Protection Area Factor Value was not scored.

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Wellhead Protection Area Factor Value: NS